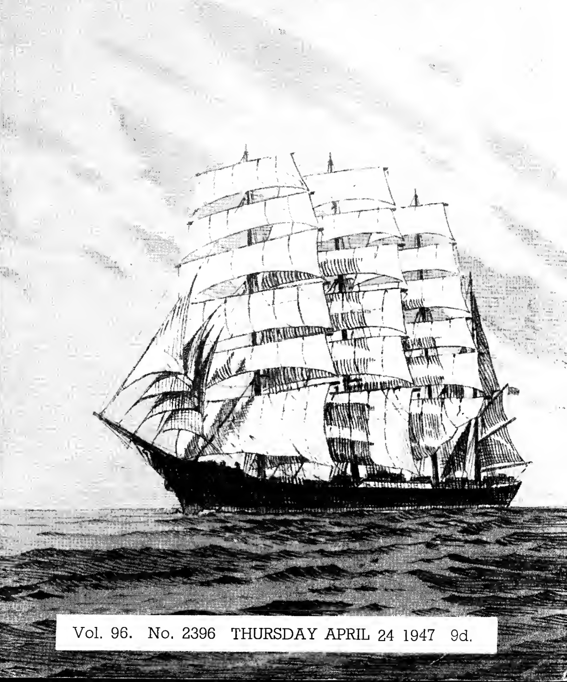
THE MODEL ENGINEER



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The MODEL ENGINEER

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24 APRIL 1947 VOL. 96. NO. 2396

SMOKE RINGS

Our Cover Picture

THE illustration this week shows the 4-mast barque "Passat," one of the last vessels of her type to be built, and one of the finest. Her dimensions are 323.5 ft. long, 46.9 ft. beam, and 26.0 ft. moulded depth. She has a poop 53 ft. long, a bridge deck 69 ft., and a forecastle 36 ft. long, and is of 3,137 tons register. She was built in 1911 by Blohm and Voss, of Hamburg, for the well-known firm of Laiesz, and sailed for years round the Horn in the nitrate trade. In 1932 she was purchased by Capt. Erikson who put her into the Australian grain trade in which she invariably made good passages. Being laid up at her home port of Mariehamn in 1939, she was later used as a grain storage ship at Stockholm. Early this year she loaded timber at Kotka, for Africa, so is once more sailing the seas. Long may she continue to do so. Our illustration was reproduced from a Sepia drawing made by the marine artist, T. L. Stocken, of Falmouth.

The Passing of Henry Ford

THE world has lost a great man by the death of Henry Ford, the pioneer of mass production in the machine shop. His influence on assembly-line methods from standard parts has spread far and wide, and has resulted in the production of manufactured goods of all kinds at previously undreamed of prices, to the benefit of the community at large. This is only one aspect of the broad conceptions of his mind, for he always thought in a big way. He set himself big targets, and by his unflagging industry and determination, and by his ingenuity in devising a new approach to his problems he invariably achieved them. There are many stories told about him and about Ford cars, some amusing and some serious, but they all throw a light on his exceptional character and ability. One which appeals to me very much is that about his attitude towards the local hospital. In looking through the morning mail his son said to him "Here's a request from the hospital for a subscription—what shall we do about it?" Ford replied, "Well, we can either send them a few dollars and forget it, or we can send them something which will really put them on their feet. Make some enquiries, and let me know their position." The enquiries were made and it was found that the hospital was sadly in need of more staff and better equipment. Ford responded magnificently, he not only subscribed dollars by the thousand, but took a personal interest in seeing that the hospital could afford the finest doctors and surgeons, and could obtain the very latest appliances to mitigate human suffering. In one respect Ford travelled a different road from THE MODEL ENGINEER. He concentrated on the elimination of manual skill in the production of his cars, the machine was to be superior to the man. Through the pages of THE MODEL ENGINEER I have consistently fostered and encouraged the development of individual handicraft. Though our objectives have been so far apart, they have not been entirely antagonistic, for mass production by machines has its roots in the skill of the craftsman who makes the accurate tools and jigs, and gauges, on which the automatic machine

depends for the exactitude of the parts it produces. The skilled mechanic will always be an essential element in the planning of industrial production, and model engineering serves a valuable purpose in encouraging and perfecting the ability to use the hands.

A Montreal "Live Steam" Corporation

ALTHOUGH the Montreal Model Engineering Society suspended operations through the joining up of some of its active members in the early days of the war, the "live steamers" in the group kept in touch with one another, and early this year they formed a new organisation, known as the Montreal Live Steamers Corporation, a body which has been duly incorporated under the laws of Quebec Province, in correct legal form. The officers are: President: D. W. Massie; Vice-President: J. Turnbull; Managing Director: F. W. Barridon; Directors: S. W. Angell and L. La Palme. The Secretary-Treasurer is Cecil Harding. Every one of the officers has built a live steam locomotive, and fifteen engine builders have signed up. Associate membership will be provided for those interested in the running of engines, though they may not be owners or builders. This news comes in an interesting letter from Mr. A. W. Leggett, of St. Lambert, who says that everything points to a successful year's running on the Corporation's track at Lachine. I am sorry to hear from him that Cecil Harding is in hospital under treatment for an internal trouble, presumably arising from war service. I am sure his many friends on both sides of the Atlantic will join me in wishing him a speedy restoration to good health. Mr. Leggett has sent me a copy of the Charter governing the formation of the Corporation, and I hope to find space for an extract from this in an early issue, as indicating the conditions on which the activities of "live steamers" have received official Government recognition and approval. Incidentally, I may mention that it was intended that the word "Incorporated" should have been used instead of the more impressive "Corporation." The change was attributable to an unintentional slip in drafting the official documents, but the "live steamers" are determined to live up to the full implications of the high-sounding title, which has been inadvertently thrust upon them.

Steam Versus Oil at Sea

MR. A. EDWARDS, of Roby, near Liverpool, takes me to task for saying in my review of the book *Ships and Men*, that as sail gave way to steam, so steam is now giving way to oil, for ship propulsion. He says "The oil (diesel) engine has encroached on steam, but up to a point only, as we still have a few good steam engineers and we know the potentialities of steam are great, whereas the I.C. engine is pretty well at its peak. To refer to the present day position all the Cunard, C.P.R., I.O.M., the *Orion*, and all the large P. & O. ships are steam-driven exclusively. The Union Castle, Silver, and Elder Dempster lines, who for many years before the war never had anything but motor tonnage, are now ordering steamers again. . . . The building returns for January for Gt. Britain and Ireland give a greater tonnage of steam-propelled ships building than motor ships, and these include reciprocating, turbine, and turbo-electric. I am anxious to mention this, as a lot of people not conversant with shipbuilding will imagine that all new ships are motor ships, and that steam is a back number. A better comment would have been 'from coal to oil,' as this would cover oil-firing as well as I.C. Practically all the large ships, except the *Orbita* and *Ordung*, of the P.S.N. Co. are oil-fired."

As a shiplover, and an admirer of the steam engine in all its many forms, I am glad to have Mr. Edwards putting forward such a strong claim for the continued life of the steamship, but I think I am still right in my contention that the motor ship is making big inroads into steam tonnage. It took many years for steam to displace sail, and I feel that steam propulsion has yet many years to live, especially in view of the constant improvements in the methods of generating and applying steam. But the number of motor ships now at sea and in the shipbuilding yards show definitely that a change is taking place, and steam will yet have a battle for supremacy to fight. I will not predict the outcome, for the advent of atomic power throws an entirely new light on the generation and application of power for all purposes, and it is quite within possibility that both steam and I.C. engines will take either a much modified form, or disappear altogether. We are living in a new world, and our old preferences and engineering idols may be swept aside altogether by the march of science. Meanwhile, I, for one, shall watch the battle between steam and internal combustion with the greatest interest, and not without some sympathy with the views expressed by my present correspondent.

To Club Secretaries

IN view of the temporary restriction on the size of THE MODEL ENGINEER, imposed by the serious position of the paper making industry, we would ask club secretaries to condense their reports of meetings and other activities as much as possible, for the time being. We are anxious to assist clubs by a reasonable share of publicity in our columns, but much of the material which enthusiastic secretaries send in is often of domestic interest only to the members of the clubs concerned, and occupies space which might be used with advantage in the service of the much wider public of general readers. I know that these reports are of value to the clubs in making their existence known, for on my desk is a letter from one such body saying: "Our membership is steadily growing and this is due in no small measure to the club notices which you have been publishing for us." So let us continue to have all the news of all the clubs, but for the time being, in tabloid form please.

Percival Marshall

A $9\frac{1}{2}$-in. Gauge Electric Locomotive

By R. H. Diggins

IT may interest some readers to hear of the model electric railway which I have installed in my garden.

The engine is an 8-wheel 2-bogie type, following the design by Mr. Dunn in "Wonderful Models," but to $9\frac{1}{2}$-in. gauge. Four motors are provided, however, one to each axle, with driving wheels 6 in. in diameter. The frames are cut out of $\frac{5}{16}$-in. mild-steel plate. Axleboxes are built up of $\frac{1}{4}$-in. mild-steel in box form, with a bronze bush fitted, and the boxes are packed with absorbent material bearing against the journal through a hole in the bush. Working leaf springs are provided, built up from $\frac{3}{4}$-in. gramophone springs.

The motors are of the Simplex type, with one big coil on top, this being the only type of motor in which the field coils are out of the way of the wheels. The armatures are $3\frac{1}{4}$ in. in diameter, by 3 in. long, with twenty coils of No. 20 enamelled and cotton-covered wire. The armatures run in ball-bearings. The field coil is connected in series, and is wound with No. 14 D.C.C. wire.

Each motor weighs about 56 lb., and is geared to the wheels by a 20-tooth on motor to 110-tooth on axle. The motors are supported on the axles by a large bronze bearing in centre, which is bolted to the field casting.

Compressed-air brakes are provided, four brake cylinders being fitted. A separate motor-driven compressor of $1\frac{1}{2}$-in. bore is provided, compressing into a cylinder, about 12 in. $\times$ 6 in. $\times$ $\frac{1}{8}$ in. thick, at about 100 lb. per sq. in. This also blows the whistle.

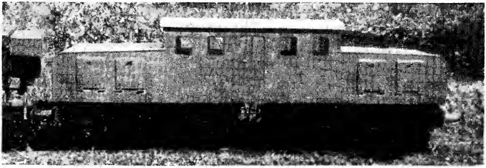
All the controls are fitted on a driving-truck, the motors being started in parallel, with a common starting resistance. Reversing is achieved by a 2-pole 2-way change-over switch, which reverses the field windings. The current supply is 100 volts d.c., and each motor takes about 6 amps. The supply is generated by a

Out in the garden on a trip, hauled by a model electric locomotive

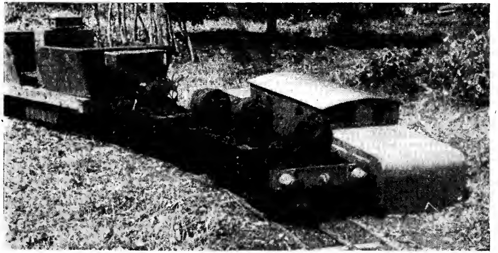
$3\frac{1}{2}$ kW 4-cylinder petrol-driven plant, the throttle of which is controlled by a solenoid that opens the throttle as the voltage falls. In the event of a short-circuit, the generator is automatically stopped.

The engine is about 6 ft. long, and weighs about 4 cwt. I should say that the engine would pull about forty people; but, owing to the lack of trucks, only sixteen persons can be seated, and they seem to be a light load.

Every part, except nuts and bolts, has been made in my shop, including patterns for the wheels and field magnets. Only three castings were used, the remainder being built up by welding or brazing.



An 8-wheeled 2-bogie type model electric locomotive

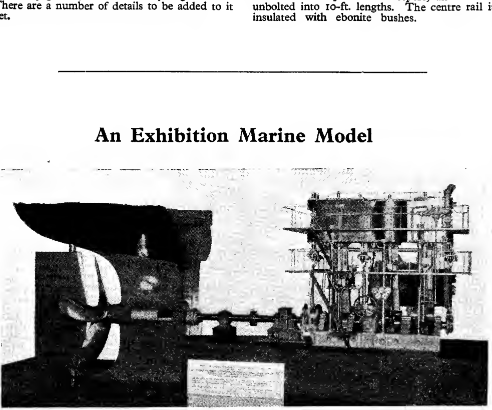


Mr. R. H. Diggins's model electric locomotive shown with the superstructure removed

The locomotive does twenty miles per hour round my garden, with two heavy bogie trucks. There are a number of details to be added to it yet.

The track is composed of ½-in. square steel, welded on to 1½-in. steel sleepers, and can be unbolted into 10-ft. lengths. The centre rail is insulated with ebonite bushes.

An Exhibition Marine Model



A 1-in. scale model of a 2,200 i.h.p. reheated triple expansion steam engine shown installed in the stern of a ship with thrust block and propeller. Exhibited on the stand of the builders, The North Eastern Marine Engine Co. Ltd., Wallsend-on-Tyne, at the recent Shipwrights' Exhibition

*COMPRESSION-IGNITION ENGINES

By "Battiwallah"

THE details for the connecting-rod were given in Fig. 4, which was included in the previous instalment.

Centre-drill one end of a piece of good quality $\frac{3}{8}$-in. square mild-steel. With the centred end steadied by the tailstock, and the other end held in the four-jaw chuck, turn down the piece to about $\frac{1}{4}$-in. diameter, for 1-in. length, leaving the same amount unturned at each end. Use a round-nosed tool. This will save a lot of filing work in shaping up this part.

Carefully mark off the crankpin and gudgeon pin centres at $1\frac{7}{16}$ in. apart, drill quite vertically at each centre-mark with a $\frac{1}{8}$-in. drill. Follow through the one hole with a $\frac{1}{4}$-in. drill and the other with a $\frac{3}{16}$-in. drill. This ensures good clean finish and, if the drills are properly ground, true holes. Alternatively, the holes can be drilled undersize, and opened out with reamers of the finishing diameters. There is, however, a risk that the reamers will be "pulled" and the holes will not be parallel.

Now file flats on the turned part to make the $\frac{1}{8}$-in. thick shank of the connecting-rod. Next, turn up two stubs of metal, preferably brass, to fit the pin holes, each fairly tightly. With one stub driven into the work and this gripped in the reverse jaws of the three-jaw chuck, one of the latter makes a drive for turning up the ends of the connecting rod. Each end means two such turning operations, and at the same time as each of these is done, the surplus metal can be turned off the sides of the bosses. Finally, the rod is shaped by filing; just a little care is needed when removing the metal which cannot be turned off from the bosses.

Case-harden the part by the process which has been explained. The requisite finish for durable wearing surfaces can be obtained by lapping There is hardly need to make special laps in this instance. If the holes have been truly bored, short pieces of $\frac{1}{4}$-in. and $\frac{3}{16}$-in. brass rod will do for the laps; use the abrasive sparingly. In finishing the crankpin boss, the finished diameter of the crankpin must be borne in mind, for it has already been made, if the sequence of these notes has been followed. Should this pin have finished undersize, then the necessary allowance must be made in the drilling. If the amount of undersize of the crankpin is only a few mils., the undersize drilling is likely to be awkward for the want of a drill of the right size. To bore out the hole with a boring tool is an awkward job because of the trickiness of the set-up. It can be done, of course, but there is an obvious moral in all this make the crankshaft to size.

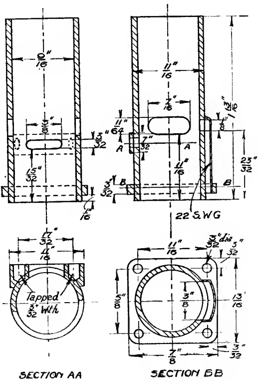


Fig. 5. Details of the cylinder

Cylinder

If you go "scrounging" round the local garage, you may be lucky enough to obtain an old worn-out car gudgeon pin which will enable you to machine out the body of the cylinder, shown in Fig. 5, with very little turning work, for the gudgeon pins are usually hollow. They are also usually dead hard, so the first job is annealing. If you are not so lucky and cannot come by the next best thing—a piece of good quality mild-steel tube of suitable dimensions, then the cylinder body must be turned from a piece of good quality mild-steel bar. Because the job is finally case-hardened, do not be

*Continued from page 476, "M.E.," April 17, 1947.

misguided by the idea that cast steel will make a better job. It won't. Turning it will be much harder work, and the chances are that when you harden it, it will distort badly.

Now let us get on with it. Turn up a mild-steel tube, $\frac{11}{16}$ in. outside diameter, $\frac{9}{16}$-in. undersize bore, and $1\frac{7}{8}$ in. long. The reason for the undersize bore is to provide the necessary allowance for lapping. This should be 6-8 mils., as there is a likelihood of a small amount of distortion when case hardening. The tool-finish in the bore must be as smooth as possible ; the rougher it is left, the more to be removed by lapping.

There are two exhaust ports diametrically opposite; the inlet and transfer ports are at right angles to these and these two are also diametrically opposite to each other. All the ports are easily formed by drilling a few contiguous holes for each, and opening them out with a file. The ports must be accurately positioned ; this is important.

From a piece of $\frac{1}{8}$-in. thick mild-steel plate, make the bolting-down flange. Turn out the centre to fit tightly on the cylinder, do not reduce this flange to its finished thickness yet, as this is done by turning later on. Drill the fixing holes to the template, using this the right side up. Now radius at 11/32 in. a short piece of $\frac{1}{4}$-in. square mild steel for the carburettor fixing boss as shown at section AA. It is advisable to drill and tap the screw holes in this before it is brazed to the cylinder, to avoid the risk of piercing the latter.

The transfer port is beaten up from 22 or 24 s.w.g. sheet iron. To make a former for this, bend a piece of 1 in. by $\frac{1}{8}$ in. iron at 11/32-in. radius—this can be done cold in the vice ; saw off a slice just over $\frac{3}{8}$ in. wide and file it to $\frac{3}{8}$ in. wide. Then go ahead beating up the transfer passage piece, making it rather full in depth. This allows for filing it to fit neatly to the curvature of the cylinder barrel. The holding-down flange can now be filed out to fit neatly over the transfer passage piece, which latter should be long enough to come right through the flange to allow for finally facing the underside.

The four pieces of the cylinder are brazed together, so the next thing is to thoroughly clean the surfaces which will be joined. The holding-down flange will secure the bottom of the transfer passage in position ; arrange the flange so that the cylinder barrel projects 3/32 in. This will allow 1/32 in. for facing up, after brazing both on the flange and the barrel. Secure the top of the transfer passage and the carburettor boss with a piece of old radiator wire—iron wire might melt whilst brazing.

Flux the joints with clean Boron and stand the assembly vertically in the brazing tray on a piece of flat firebrick, with the transfer passage facing you, and surround the job with coke in the usual way. When it has been heated to a bright red, touch the top and sides of the transfer passage with thin brazing wire so that a small quantity is melted, and follow quickly with a touch of the spelter on the holding-down flange. Then, lightly holding the work with tongs, turn it round so that a touch of spelter can be applied to the carburettor boss. Keep up the heat for a minute or so to allow the spelter to run round all the joints thoroughly. If the work has been properly cleaned and fluxed, the spelter will run quite freely where it is required. If the spelter is applied too liberally, then it has to be cleaned off afterwards if, as it should be, a neat looking job is desired. This cleaning business is very tedious.

The cylinder can be cased while it is still red-hot after the brazing operation. Have a shallow small tray of Kasenit or potassium ferrocyanide handy, immerse the cylinder in it, taking care to do this gently, for it is rather fragile while red-hot and therefore easily distorted. By the way, potassium ferrocyanide is bought in lumps, and must be reduced to powdered form for case hardening.

Reheat the work for five minutes or so, to allow carburisation to take place, and let the work cool off slowly. Then clean it up—that is tidy up the brazed joints with a file, face to finishing thickness the bottom of the holding-down flange and the ends of the cylinder turned down to the dimensions as Fig. 5 ; also face up the carburettor boss, if this has not already been done.

Now harden out in the same way as for cast steel, but be careful to keep the temperature below the melting-point of the brazing ; this precaution is also necessary for the carburising process. A middle-cherry red is a safe heat, and hot enough for carburising and hardening.

A lap has to be made for finishing the bore. This can be done in the same way as has been explained for the bearing lap. Make the taper $\frac{5}{16}$ in. at the small end and 1/64 in. larger at the other end, the taper being about 3 in. long. Use No. 12 s.w.g. copper wire for the lap. These sizes are not absolutely necessary ; they can be varied to suit a larger or smaller wire which may be at hand, although it should not be too small, or the turns will come adrift when the tool is being used. After the copper wire wrapping has been soldered, turn it to $\frac{9}{16}$ in., quite parallel, or the cylinder bore may finish tapered.

Carry out the lapping at a speed of about 300 r.p.m. Work the cylinder to and fro constantly and work down the high spots which you will feel, for the lap will tend to grip at these places if it is properly adjusted. Do not forget that nothing is gained by swamping the lap with abrasive. As the lap works evenly and freely at a particular setting, tighten it up a little and work it until it feels free again. Keep repeating this until the whole of the bore is brightly polished. For the finish, use the lap almost dry. Some prefer to finish off with metal-polish as the abrasive ; I think this is a matter of taste, for as good a finish can be obtained with a good quality fine-grade lapping compound. To remove the tool marks, and the effects of any slight distortion which may have occurred when hardening, it may be necessary to remove 6-8 mils. of metal, and the whole lapping operation may thus take three hours or so. As this is one of the most vital operations in the construction of the engine, it is time well spent. Do not regard it as finished until every scratch is removed from the bore, and the almost-dry

lap grips the work with an even "feel" for the whole length of the cylinder.

Soldered Components

As an alternative to brazing, the cylinder components can be soft-soldered together, but the job will not be so strong. The cylinder barrel should be reduced to form a shoulder for the holding-down flange, and the latter bored out for the corresponding size. The barrel should be carburised before the shoulder is turned down, because the barrel must be hardened before the soldering is done; in this way the hard casing will have been removed for the final facing of the holding-down flange and the cylinder end. Very light cuts must be taken in doing this. As for the brazed-up assembly, leave the lapping until the last; if this is done before the soldering, there is a chance that the heat will cause a slight distortion.

These engines run so cool that there is no probability that the solder will melt. In fact, you will be told later to soft-solder the piston top.

If the soldered assembly is decided upon, and the crankcase casting has already been counterbored to $\frac{11}{16}$ in. at the top, then a small packing ring must be made for the reduced diameter of the cylinder end.

Piston

Reduce one end of a 2-in. length of good quality mild steel $\frac{5}{8}$-in. diameter bar to $\frac{3}{8}$-in. diameter, for a length of $\frac{7}{8}$ in.; this makes a chucking piece. Bore the large end to $\frac{1}{2}$-in. diameter for a depth of 1 in. and drill accurately at the bottom of this bore a $\frac{1}{8}$-in. diameter hole. Having measured the exact diameter of the cylinder bore by "miking" the lap used for finishing it when the lap is adjusted to a tight fit in the bore, reduce the piston piece to a diameter about 6-7 mils. larger to allow for finishing. Trim off the end of the piston to make the $\frac{1}{2}$-in. bore $\frac{13}{16}$ in. deep, and then carburise the whole piece in Kasenit or potassium ferrocyanide, but do not quench. Holding the work by the chucking piece, turn the treated skin off about $\frac{1}{4}$ in. of the reduced end and also turn down at the top of the piston to $\frac{3}{8}$-in. diameter, so that the piston is $\frac{7}{8}$ in. long. Now reheat to cherry red, and quench. This leaves the piston top soft for countersinking, and the chucking piece soft for parting; but these things must wait.

A Critical Job

The piston now has to be lapped down to fit the cylinder. This is a critical job; taking off the metal will put you "on your mettle." Make an internal copper lap $\frac{1}{2}$ in. thick to fit a screw die-holder, as was explained for the crankshaft, this lap being lathe-bored $\frac{9}{16}$ in. Hold the work by the chucking-piece, so that about $\frac{1}{2}$ in. of the latter is clear of the chuck jaws. Lap at about 300 r.p.m., and, to remind you again, clean off the old lapping compound and renew it frequently. Do not run the lap too tight, and work down the high spots which you will feel. Also "mike" the diameter occasionally, so that you can check for parallelism, and know when you are getting near to finishing size. When trying the cylinder on the piston for fit, ensure that every vestige of abrasive is cleaned off both parts with a clean rag. When the piston will just enter the top or the bottom of the cylinder for about $\frac{1}{4}$ in. you are very nearly "there." Now this is important; meticulously clean piston and bore, and smear the piston lightly with clean tallow. Try the fit again and you will find that the piston will enter farther and easier. If it will fit fairly tightly throughout the bore, leave it at that. Otherwise lap off just a little more until the tallowed piston just fits throughout the bore, fairly tightly. Always allow the piston to cool right down before trying the fit, because if it is several degrees hotter than the cylinder, it will apparently not fit, while when the two parts are at equal temperatures, the fit may be too easy.

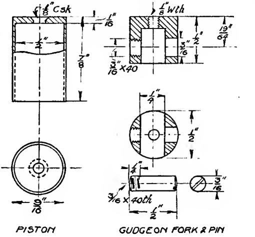


Fig. 6

The final fit is obtained by running the piston in the lathe at a very low speed, treating it with clean tallow, and working the cylinder to and fro slowly along the piston; use no abrasive for this. By this means, a fit so neat can be obtained that by holding the piston in the hand for a few minutes and leaving the cylinder in the cool air makes the fit almost "no go."

Now it is a peculiar thing, that lubricating oil is no substitute for tallow in this final fitting process; neither thick nor thin oil will do. The piston will bind in the cylinder if you try to finish off with oil instead of tallow, and when what is thought to be a fit is obtained it will, in reality, be too slack.

The fork piece for the gudgeon pin and the pin are straight-forward jobs, the dimensions being as Fig. 6. The first should fit comfortably in the piston skirt; if it is tight, the piston will be distorted. The dimension given for the distance between the top of the fork piece and the gudgeon pin centre allows for 1/64 in. of asbestos packing under the piston top. Make

(Continued on page 511)

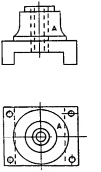
*A Tandem Compound Engine

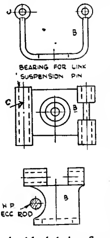
By "Crank Head"

THE next item to be taken in hand was the governor and it was decided this should be Hartnell's, a type well known and one in which the action of the balls is utilised to control the expansion-valve working on the back of the h.p. slide-valve. Details of the valves will be given later on.

The first portion to be made was the pedestal (see A, Fig. 11), the base of which is of cast-iron, cut from a solid piece of iron 4 in. × 2 in., another relic of the railings previously referred to. The production of this piece involved the expenditure of an enormous number of foot-lb. of energy, two hacksaw blades, and a lot of perspiration. But once this was licked into something like shape, the rest of the work was done in the lathe.

Fig. 11





It was now time to make what, for want of a better title, shall be named the superstructure, shown at B, Fig. 11. This was a piece of ⅛-in. steel plate bent in the form of a letter U, and bored to be a shrink-fit on the spigot at the top of A; two pieces of ⅜-in. round steel were then cut to length, and a slot cut along their length, which was a fit on the top of the limbs of the U. They were then silver-soldered in position, and piece B shrunk on to A. The function of these pieces is: one to take the suspension pin for the link, and the other, to form the bearing for the levers which control the vertical movement of the die-block in the pendant-link.

It is as well to describe the method of cutting the slot in link, and making and fitting the die-block to it. The link was marked off on a piece of ¼-in. thick steel, and holes of a suitable size drilled at each end of the slot. The plate was then clamped back tightly on the faceplate, (a piece of paper being placed between the faceplate, and the link blank for two reasons, the first, and, in this case, the more important, being that it could more readily be seen when the milling-cutter had cut right through the link, and the other to prevent the link moving under the influence of the milling operation), in a position such that the distance from the lathe centre to the link was the correct radius, when the mandrel of the lathe was turned.

With a milling-cutter mounted on the vertical slide in the slide rest, the slot in the link was milled out to its correct form, as can be more clearly understood by reference to Fig. 14. The milling-cutter was held in the grinding-spindle, and driven from the overhead gear, and the lathe mandrel was rotated by means of a worm, and worm wheel, the latter on the end of mandrel. This gear was originally designed and made for graduating the base of the new slide-rest.

The die-block for the link was turned, the method adopted being as follows: A piece of bronze of suitable size was held in the machine vice, which was secured to the lathe faceplate in such a position that an ordinary turning-tool could be held in the slide-rest, at the correct distance from the centre of lathe, to produce a curve of the correct radius. The lathe mandrel was then oscillated by hand, the outer side of the block being first turned, and then the inner side. Care was taken in the setting-up in each of these operations, the result being a die-block which fitted the link perfectly when it was removed from the lathe, no filing, or other hand-work being required.

The profile of the link was now completed, pin and oil holes drilled, the link suspension pin being turned, and the whole tried in position C, Fig. 11. Attention was now turned to the yoke carrying the bell-crank levers and balls A and B, Fig. 12. The former is shown in plan and elevation at A, Fig. 12. This was also cut from a solid piece of cast-iron, derived from the same source as the pedestal, and involved a large amount of work. After having been roughed out by sawing and filing, the roughed-out yoke, with the cylindrical portion containing spring left longer than finished size, was held in the chuck with the forked end outwards, and wherever possible was machined. This included boring for the spring, shaping the arms of the fork, counterboring to allow full lift of the sliding sleeve when working, and marking off the positions of the holes for the fulcrum pins of the cranked arms B. This operation is much more quickly described than accomplished; however, it was eventually completed, and the whole parted off, and preparations made for the next operation, which was boring the tapered hole (morse taper) to accommodate the vertical spindle.

*Continued from page 469, "M.E.," April 17, 1947.

A mandrel was turned in the chuck to fit the bore of the yoke with the forked end towards the chuck. The yoke was forced on the mandrel and the hole in top drilled, and bored to a morse taper, and the end faired off for seating of the nut on the end of the spindle. This completed the turning on this part of the job.

The spring retaining sleeve was then made a sliding fit in bore of yoke, and at the bottom end bored an easy fit for the spindle. The spindle is a piece of 7/32-in. silver-steel (see Fig. 15) and does not call. for any description. The sleeve of mild-steel, C, was then turned, and bored a good sliding fit to the spindle.

off close to the hole. Having learned that lesson, the second fork was heated with the blow-lamp flame whilst held in the vice, and then operated on ; not too good for the jaws of the vice, but there appeared to be not much in the way of an alternative. Anyhow, the operation, so far was successful, and the patient did not die !

The next thing to be done is to file off all sharp corners and saw marks from the partly-completed fork ; this operation will go a long way to prevent the formation of cracks during the process of shaping forks. A piece of flat bar is now shaped at the end to the profile of the finished fork inside, the fork is again heated,

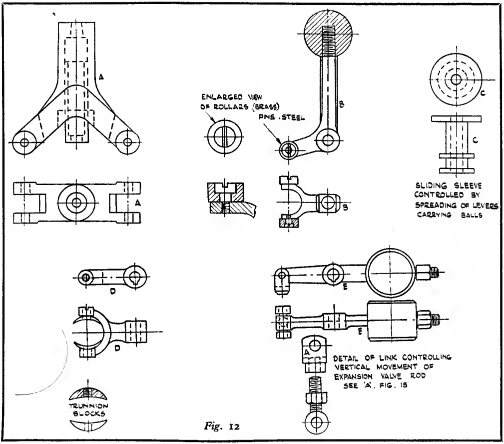


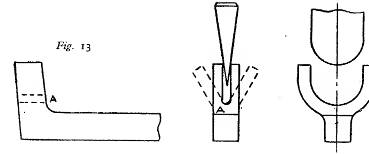
Fig. 12

The next operation was the manufacture of the bell-crank and other forked levers D and B, Fig. 12. Taking B first, a piece of steel thick enough to clean up was cut roughly to size and shape (see Fig. 13) ; a hole 3/32 in. diameter was then drilled through in position A, and a fine saw-cut made from the end to meet A. The portion then split was opened out by driving a wedge into the saw-cut ; but this cannot be done cold, as the writer thought, and he had to make another for his trouble ! It would appear that, no matter how good-tempered the metal is, it will not stand up to that treatment, and breaks

and the shaped flat bar driven gently between the jaws. This operation must be taken easily, and continual attention paid to see that one side does not open more than the other. If this happens, a lot of difficulty will be met with in trying to rectify it ; with care, the trick can be done as has been described.

Having forged the two bell-cranks, they can now be marked off, and shaped up to finished sizes. The only part which the lathe can play in the remainder of the work, is turning and screwing the shank to carry the balls, and, if it is considered worth the trouble, to face up and

Fig. 13



die block shortens or lengthens the travel of the expansion-valve; when the die-block is at its lowest position in the link, the travel of the expansion valve is greatest. Reference to the photograph showing close up view of the governor-gear will probably make this much clearer than the writer has been able to do.

It may be here stated

drill the bosses. It will be noted that the bell-cranks are not 90 deg.; actually, the angle is 105 deg., but there is no reason why this should be so, save that of expediency.

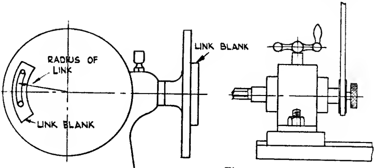


Fig. 14

Fork D, Fig. 12, can be machined up from a solid piece of metal, so few remarks are called for. Looking at D, Fig. 12, it will be noted there are two crescent-shaped pieces of bronze described as trunnion-blocks; these are pivoted at the extremities of the forks and are a sliding fit between the two lower collars on the sliding sleeve C, their function is to convey the vertical movement of C (under the influence of the centrifugal force of the balls when revolving), through the shaft on which D and E are keyed to the expansion-valve rod (see Fig. 15) and through it to the die-block in the pendant link. The rising or falling of

that the making of the governor, although it took infinitely longer, was much simpler and more to the writer's taste than trying to describe it on paper. It is hoped, however, that the accompanying sketches will fill the many gaps in the written sentences.

Fig. 15A illustrates the spindle and yoke retaining-nut, also the ornamental cap-nut, which is of gun-metal. Fig. 16 is the shaft for driving the governor, with its bearings, both of

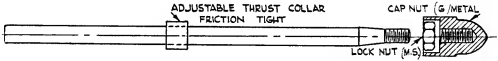


Fig. 15A

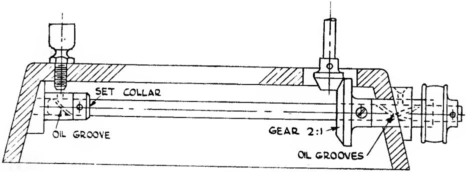


Fig. 16

which were built up and then silver-soldered, the bevel gear, and lubricator for outer bearing, and driving pulley does not need much description, with the exception of a reference to the set-screws securing the gear wheels. These screws are of silver-steel, and hardened on the business end, which latter is shaped like a female centre, and when screwed up tightly leave nothing to be desired as far as grip is concerned.

It will be noted at E, Fig. 12, that a counterpoise weight has been fitted to balance the weight of the expansion-valve rod and die-block. This may only be a temporary measure, as, in some cases, Hartnell's governors are fitted with a dashpot arrangement to damp out any tendency for the gear to hunt; so it will not come as a shock to the writer if experience proves this to be necessary.

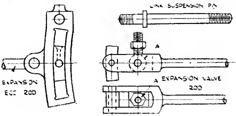
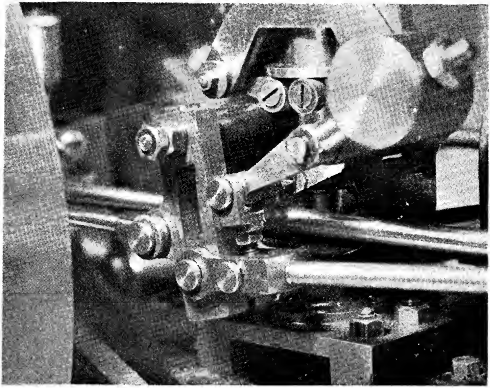


Fig. 15

(To be continued)



A close-up of the governor-gear

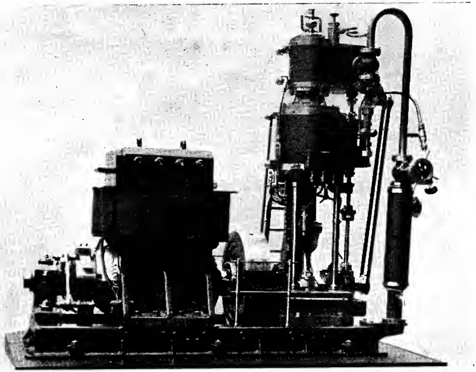
Compression - Ignition Engines

(Continued from page 507)

the pin from mild-steel, lap-finish it to fit the connecting-rod, and case-harden it. There is no need to case harden the fork, because it has no working parts.

Provided you are satisfied that the piston fit is all that is to be desired, the holding-piece can now be parted off and the ⅛-in. diameter hole countersunk at the top. Hold the piston *at the top with the tightened lap* while doing this. While still so held, assemble the piston parts and the connecting-rod with a ⅛-in. Whit. screw, placing 1/64 in. of asbestos packing under the piston top. Seal the screw-head with tinman's or plumber's solder; the former will not melt.

(To be continued)



A Model Direct-Coupled Steam Engine and Dynamo

By W. T. W. Rolls

THE writer some time ago was reading a history of early electrical generating plants in this country, and as a result, became obsessed with the idea of building a model of a typical direct-coupled engine and dynamo of about the 1890 period.

The competition between the leading engineering firms was very keen to produce the most reliable engine suitable for direct coupling to a dynamo ; as a result, some very fine workmanship was necessary if the engine was to stand up to continuous running at the high speeds required.

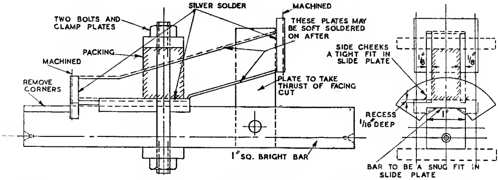
It must be remembered that forced lubrication had not been invented by Charles Payne till 1890 ; his well-known method, which is adopted in practically every type of reciprocating engine today, has made the open-type engine become a thing of the past.

The model is made to a scale of $1\frac{1}{2}$ in. to the foot, and represents a 10-in. × 16-in. × 10-in. stroke tandem compound. The only castings used were for the cylinders and dynamo field magnets ; the rest is all fabricated while the bedplate is made of a special section angle bronze bar. The back standard is built up of bright mild-steel and the method of construction and machining of same is shown in the accompanying drawing. This method ensures the top flange and foot being truly square with the slide face. With regard to the connecting-rod, the method shown for making this may appear to be very elaborate, but I have seen so many otherwise fine models spoilt by bad designs of fork ends to the rods, many of the commercially made ones being the worst. It is essential that the curves of fork should be truly circular ones and to do this on a small lathe with spring form-tools is a doubtful proposition ; I therefore decided to turn the fork as a complete semisphere, removing the surplus metal progressively as shown in the drawing.

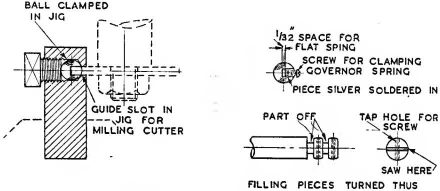
Regarding the dynamo the armature was obtained complete from an old car dynamo set ; it is $3\frac{1}{2}$ in. diameter by $3\frac{1}{2}$ in. long ; the field magnets, were schemed out to the design of the period mentioned and not with a view to any stipulated output. The engine has been under 100 lb. per sq. in. air pressure and attained a speed of about 4,000 r.p.m., running light.

The overall dimensions of model are as follows : Length, $17\frac{1}{2}$ in. ; width, $9\frac{1}{4}$ in. ; height, 16 in.

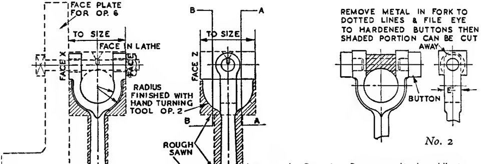
This model was on show at the 1946 MODEL ENGINEER Exhibition, and another photograph was published on the cover of the August 22, 1946, issue of THE MODEL ENGINEER.



Method of building up back standard, showing jig bar for machining flange and foot between lathe centres



Method of making slot in balls for Pickering type governors



1st Operation	Prepare steel to dotted lines.
2nd ,,	Turn in lathe to profile gauge and face ends.
3rd ,,	Drill hole for crosshead pin—true to faces "X & Y."
4th ,,	Saw off metal at A-A and bore hole through fork on lathe faceplate true to face "Z" and square with face "Y."
5th ,,	Saw off metal at "B-B"
6th ,,	Bolt to faceplate as shown and bore big-end.
7th ,,	Finish fork-end to thickness at "E," and file eye to shape, as per sketch No. 2.
8th ,,	Drill bolt holes in big-end and split.

Method of machining connecting-rod (not to scale)

TRACTION ENGINE

A $1\frac{1}{2}$-in. scale Burrell Single-Crank Compound-Type

By G. R. Cross

THIS engine has occupied several years of my spare time and has always been a favourite right from the time when I was a boy down on the farm.

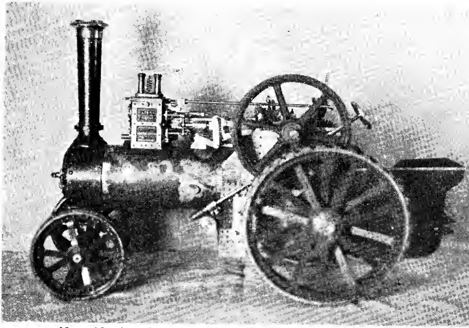
The cylinder of this engine has taken up a considerable amount of time in order to get the correct design embodying every detail. Patterns were made with cores showing cylinder bores ready to be machined. I made a pattern with steam ports cast in ; in the casting these proved to be rather too large ; all the same, I decided to carry on and had got well on the way to the finishing state when, on drilling the passageways to the steam ports, I discovered that the drill had just pierced the steam jacket of the H.P. cylinder ; due to an oversight, I had undercut the bores to allow for steam jacketing, and in doing so I undercut too near each end of cylinder. Actually, I had only left a bare $\frac{3}{8}$ in. instead of $\frac{1}{2}$ in. for cylinder liner bore. Well, I decided there and then to scrap same and redesign and make a fresh pattern with steam ports not cast in ; this, readers will notice, is practically completed less governors, which are to be fitted. The boring out of cylinders and undercutting for steam jackets called for plenty of thought, as both bores had to be dead parallel ; the operation was performed on my Drummond 4-in. lathe, the casting being bolted to the faceplate and balanced.

The low-pressure cylinder was first bored out, this being the larger of the two and more suitable to take a mandrel for boring the high-pressure cylinder. The mandrel was made and screwed $\frac{3}{8}$ in. Whit. at one end with nut. This was bolted to the faceplate together with the cylinder and the operation repeated for boring the H.P. bore, at the same time facing-up one end of cylinder to take one of the covers and then reversed to face the other end.

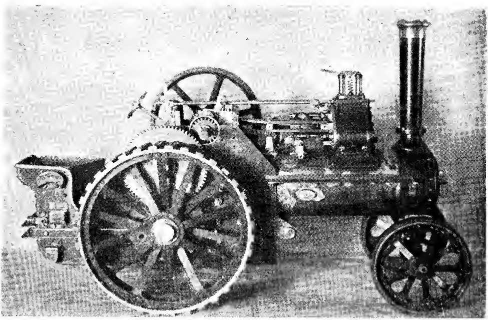
Liners

I next turned my attention to the two cast-iron liners. Before these were fitted, I had to drill passageways from the saddle to the regulator steamchest ; this could not be done with the liners in position. After the liners were fitted, I bored them out to finished sizes and lapped them ; bore sizes : $\frac{7}{16}$ in. H.P. ; $\frac{3}{4}$ in. L.P. ; stroke, 1 in.

The ports in the valve-chests required a little planning, and the only way I could see of machining these was to make a drilling template,



Near side view of Mr. Cross's model traction engine during construction



An excellent model in the making

then to use a drifting tool partly to clean these out and then finish off by filing. This turned out very satisfactory.

I next end-milled the port faces and regulator valve-face. The passageways from each cylinder bore to valve-ports were next contemplated. This was not so simple as our locomotive brothers find matters. The valve-chests and the regulator steam-chest are cast with the cylinder and are not separate ; therefore the passageways from each port to the ends of the cylinder bores had to be scribed out on top of the cylinder, showing the exact direction in which the drilling had to be performed and angle which cylinder had to be held in machine-vice. There were two 3/32-in. drillings to each port ; then these were filed through. The drilling of the exhaust ports was a simple matter ; the H.P. was drilled from the top of the cylinder and right through to the L.P. port ; then the exhaust from this cylinder was drilled from under the cylinder meeting the port. This part completed, it was then tapped and plugged. The exhaust passageway to the chimney was drilled $\frac{1}{4}$ in. and has the correct flange-fitting pipe.

Valves

All glands are made from brass rod, slide-valves are made from gunmetal, while the port and back covers, also the valve cover, are castings in iron ; so is the crosshead. Crankshaft is built up, connecting-rod machined from the solid in mild-steel, as is the Ramsbottom safety-valve. This valve, by the way, has to stand a working pressure of 80 lb. sq. in. There are seventy-two 3/32-in. and $\frac{1}{16}$-in. steel studs fitted to this cylinder, excluding the holding-down studs to boiler, of which there are twenty-six.

Boiler

The boiler is copper, $3\frac{1}{8}$ in. outside diameter, $9\frac{1}{2}$ in. long ; the firebox is $3\frac{1}{4}$ in. $\times$ $3\frac{1}{4}$ in. and has twelve $\frac{3}{8}$-in. O.D. copper flue tubes fitted. All is riveted up and brazed, and has withstood a steam test of 100 lb. The boiler has fittings to take water lifter, injector, pressure-gauge, water-gauge and water feed-pump clack boxes. The smokebox is a mild-steel ring turned up to fit the boiler. The smokebox door ring is a casting in gunmetal, with hinges cast on. The door was hammered out of sheet steel and shaped, the ring being brazed on. The Burrell nameplate on smokebox door is a casting.

The chimney and base are castings in gunmetal and brass ; so is the fore-carriage for the front wheels. The clasp was turned from solid mild steel. All wheels are built-up ; the T-rings were cast in brass.

The tender is made of heavy-gauge steel plate, as are the horn-plates. The water tank is copper, riveted and soft-soldered ; a water lifter is fitted, and was built up and silver-soldered ; hose-pipe bracket, foot plates and inspection plate are fitted, but beading around tender is yet to be fitted. The flywheel is of cast iron and is $5\frac{1}{4}$ in. diameter with a $\frac{11}{16}$-in. face.

With our Editor's permission, I shall be happy to continue with a further chat on the completion of this engine and its running tests, with further photographs, at some future date.

The "STIRLING"

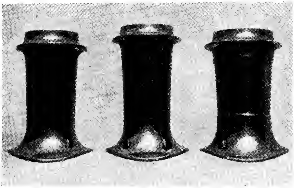
CAST-IRON CHIMNEY

MR. KENNETH LEECH, referring to Mr. F. C. Hambleton's drawing of the cast-iron chimney of the G.N.R. 8-ft. single-wheeler, No. 1, reproduced on page 499 of our issue for November 21st last, writes :—

"THE MODEL ENGINEER is a journal in short supply nowadays, and it was only by chance that I was able to look through a set of recent issues the other day. I was rather upset at our friend Hambleton's idea of a Stirling cast-iron chimney on the 8-footers. I am afraid he has got hold of the Ivatt version of that chimney, and not the much more graceful Stirling original. Here is a drawing I made from a Doncaster blue-print loaned to me by a friend; the centres from which the draughtsman had struck his radii were clearly visible on the blue-print, and I have scaled them off. I may add that, in spite of the restriction of the shorter chimney to type A1 (Nos. 1003-1008), all the 7-ft. 6-in. singles and a number of 8-footers had it, *e.g.* 666, 667, 671, 774, 777 and some others, but *not* when built.

I made a couple of ¾-in. scale chimneys to the drawing; and they look right, except for the thickness of the rim, which, undoubtedly, was actually made rather thicker; and the shorter chimney usually had a rather higher top. This was, I suppose, due to the still-continuing Doncaster practice of verbal instructions to the shops first, and drawings later. But the compound curves below the lip and on to the smokebox are definitely in agreement with the Stirling chimneys and not with the Ivatt ones."

One of the first items in the policy of THE MODEL ENGINEER is to pass on to its readers any information, official or non-official, that would not only help to ensure accuracy in models, but might be very difficult, if not impossible, for the more meticulous amateur to obtain. Nobody can deny that Mr. Leech possesses a keen observation, and the photograph of his ¾-in. scale reproduction of the Stirling cast-iron chimneys clearly indicates that he is an expert at model-making; in fact, we know him to be so. But he is also a most careful recorder of minute details, and from the correspondence we have had with him regarding Stirling chimneys, we have extracted the following information which we know will be of interest and use to those many readers who still cherish Patrick Stirling's work.



Mr. Kenneth Leech's ¾-in. scale models of Stirling chimneys. Left : The short cast-iron ; Middle : The long cast-iron : Right : The built-up type

There seems to be no room for doubt that the 7-ft. 6-in. single No. 232, Works No. 389 of 1885, was the first G.N.R. engine ever to have a cast-iron chimney when built. A sister - engine, No. 238, Works No. 390, was, of course, building at the same time and also had the cast-iron chimney; photographs exist to prove this.

With regard to the 8-footers however, Engine No. 772, Works No. 380, had a built-up chimney when new, and several known photographs put this beyond doubt. But Engine No. 773, Works No. 393, had the cast-iron chimney when officially photographed, and this naturally raises the question as to whether this fact alone *proves* that she was the first of her class to be so fitted. The evidence is, perhaps, scarcely conclusive by itself; so let us see if anything can be added to it.

Up to the present, no photographs have been brought to light to show engines built to Doncaster Works numbers 381 to 388, inclusive, which covered : four 0-4-4 tank engines, two 2-4-0 tender engines and two 0-6-0 saddle-tank engines; but we do know that a batch of 2-4-0 tender engines with the running-numbers 708 to 715, and built by an outside firm in 1884, had built-up chimneys. It seems a safe assumption that a new Doncaster design, incorporating steel boilers and frames instead of wrought iron, and non-standard dimensions, like the 2-2-2 engines 232 and 238, would be the starting-point for a new design of chimney. All other possible engines came half-way through batches. The 8-footers were built in pairs, Nos. 771 and 772 being twins, and 773 and 774 likewise; so, in view of what has gone before, here is another clear indication that No. 773 was the first 8-footer with a cast-iron chimney.

But what of the chimneys themselves? The 3-ft. 3-in. and 3-ft. 5-in. lengths shown on the Doncaster drawing are not the correct dimensions

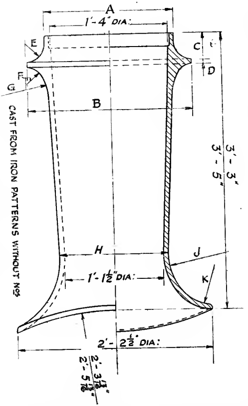
to bring the top of the chimney to 13 ft. 4 in., or 13 ft. 4¼ in. above rail level, the figures usually given on Doncaster general-arrangement drawings. But the latter have sometimes been quite unreliable in that marked dimensions differed widely from those scaled off the drawings!

The observed facts from some 200 photographs are that, on the 8-footers numbered between 1 and 1002, there *were* two main sorts of cast-iron chimneys, one shorter and with a rather deeper top section above the lip, than the other. This shorter chimney agreed in every way with those fitted to the 2-2-2 engines Nos. 229 to 240, 871 to 880 and 981, and these engines never had the longer chimneys in Stirling's day. It is clear that nobody worried which chimney was put on the 8-footers, but the longer one on the 2-2-2 engines would have been outside the gauge dimensions.

Mr. Hambleton does not agree that the 3-ft. 3-in. dimension was the length of the shorter type, and 3-ft. 5-in. that of the longer one; he seems to base his view on the general-plus photographs which he has scaled. But foreshortening, always present in photographs, makes measurement to ½ in. a very difficult matter indeed.

Mr. Leech has made ¾-in. scale models to both lengths, but has produced a deeper top on the shorter one. The radii at the base and below the lip are certainly correct; but the radius above the lip is correct only for the long chimney and too small for the short one with deep lip. The latter, therefore, was probably a modification which did not get on to the drawing.

Photographs taken from about 1898 onwards show minor variations in lip height and thickness. Evidently, by this date, the old patterns, worn out, had been replaced, and, later, Ivatt-shape patterns replaced these newer Stirling patterns.



Drawing of the Stirling cast-iron chimney, based on an official blue-print. Dimensions: A, 1 ft. 5½ in.; B, 1 ft. 10½ in.; C, 3¾ in.; D, ¾ in. (estimated); E, 2½ in.; F, 2½ in.; G, 7½ in.; H, 1 ft. 2⅞ in.; (estimated) J, 8 in.; K, 5 in.

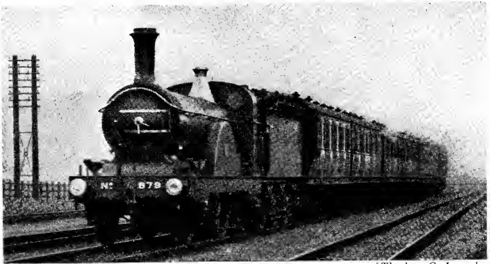


Photo by] [*The late C. Laundy*

Up Letchworth train photographed in October, 1910 *2-2-2 engine No.* 879 *with a Stirling cast-iron chimney*

"L.B.S.C." describes how a "Might-have-been" comes to life

THERE is one privilege available to all builders of little locomotives, which is a source of pleasure to many, including your humble servant. That is, if you have any ideas as to how the design of any class of full-size locomotives could have been amended, improved, or altered with some advantage, you can go right ahead and build a little sister incorporating any variation desired, and try it out on the road. I've often done it, the last example being "Jeanie Deans," the little L.N.W.R. Webb compound which does everything her big sister didn't; and am also making some improvements to the L. B. & S.C.R. single-wheeler "Grosvenor" by adding the refinements which old man Billy would certainly have provided, had they been in vogue in his time. Now, a lot has been written and said about the "Lord Nelson" class engines on the Southern Railway; much of it to their disadvantage, mostly by prejudiced folk. I know many people, for example, who acclaimed Sir H. N. Gresley for launching out with his famous "galloping sausage" (No. 10,000) which didn't exactly shine in the galloping line until completely rebuilt and transformed from a four-cylinder compound with a water-tube boiler, into an ordinary three-cylinder simple with the usual type of boiler. Those same folk thought it was all wrong when Mr. Maunsell did a bit of experimenting in a different way, and tried the effect of a four-cylinder simple with 135 deg. cranks giving eight beats per turn. Very few designs perform miracles when first put into service; with either big or little engines, "drawing-board results," and actual performances on the road, are entirely different matters. Because the *calculated* tractive effort of an engine is, say, 40,000 lb., it doesn't follow that she is going to haul 500 tons up the side of a mountain as easily as she would a sack of feathers, nor run two miles in a minute on the level. Defective setting of one valve will cattle up the whole works; so will a bit of bad coal, or a driver and fireman who are not masters of their craft.

When the first L.M.S. Pacific, *Princess Royal*, came out, it appeared that here was an engine that would do the doings, if ever there was one. She had virtually the "works" of a G.W.R. "King," "tried, tested, and not found wanting"; and a huge boiler that, according to its calculated heating surface, should have made all the steam the cylinders could use under any condition of working. Yet it was not until certain alterations and adjustments were made, that the engine realised expectations. It was the same with the "Nelsons." At first, they did not do all that was expected of them; but given time, all defects could have been (in fact they eventually were) remedied, and full success achieved. One fault lay in the arrangement of valve-gear, and the valve setting. Now many full-sized locomotive engineers who know the capabilities of Mr. H. Holcroft as an expert on valve-gears, are of the opinion that, had the arrangement of the valve-gear been left entirely to him, very different results would have been achieved at the outset. The splendid example of a $3\frac{1}{2}$-in. gauge locomotive illustrated here, shows a "Lord Nelson" type engine as it might have been, with the four cylinders, 135 deg. cranks, and the Holcroft valve-gear.

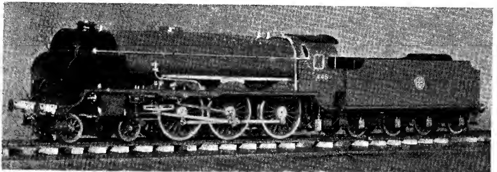
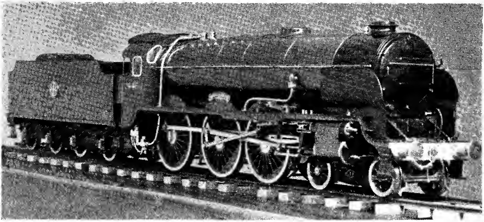


Photo by] [*J. A. Smith*

"Lady Anna"—driver's side

"Lady Anna"

Followers of these notes will not need any introduction to Mr. A. W. G. Tucker, of the Bramhall Light Railway and its fleet of "Annas." Anna is a name you can't spell backwards, and our worthy friend certainly hasn't had his constructional lever in back gear since he took up locomotive building; even the railway itself is an asset to the garden, as those who recollect the pictures of it will agree. After finishing the Garratt-type engine, Mr. Tucker thought he



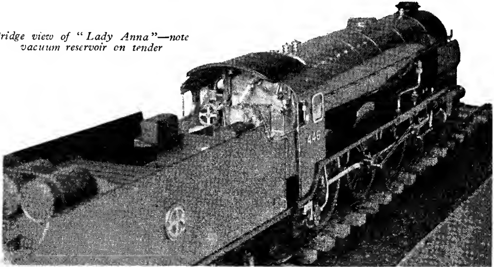
"Lady Anna"—fireman's side

would have a shot at building a Southern "Lord Nelson" in $3\frac{1}{2}$-in. gauge, but instead of making a slavish copy of the original, decided to incorporate certain variations, including the Holcroft arrangement of conjugated gear for operating the valves of the inside cylinders. The result you see in the reproduced photographs, the originals of which were taken by that knight of the camera who richly deserves the title "photographic artist," to wit, Mr. J. A. Smith, of Failsworth, who possesses a common name combined with uncommon skill! Mr. Tucker pays tribute to the immense amount of trouble he took in obtaining such fine pictures of a "spit-and-polish" job, the various lights, shades, and reflections being quite a problem requiring special treatment.

The four cylinders were milled out of three rectangular blocks of gunmetal, the two inside cylinders being in one block; and this involved taking off quite a considerable amount of metal, not only for appearance, but to prevent the front end of the engine being excessively heavy. As it is, even with a leaden drag-weight under the footplate, the centre of gravity is half-way between the first and second coupled axles. Proper piston valves are provided, which were run in with "Oildag," under steam from a separate testing boiler. The wheels will turn at 76 revs. per minute with the die-blocks only $\frac{1}{8}$ in. off the middle of the expansion-links, and only 5 lb. pressure, the turning movement being absolutely even, which is a tribute to the correctness of both the outside Walschaerts and inside Holcroft gears. Lubrication is looked after by a mechanical lubricator with a pump made as described in these notes, but the drive is in the middle of the tank, and all the ratchet gear is entirely enclosed.

The motion, guide bars, and brackets, are all milled from solid, and the latter especially involved a considerable amount of work. So did the reversing gear; Mr. Tucker used the ingenious wheeze of cutting a long two-start

Bridge view of "Lady Anna"—note vacuum reservoir on tender



screw, and then hardening and fluting a part of it to use as a tap for the nut. Other jobs that took a long time were the running boards, footplate, and cab. Our worthy friend says it takes a lot of scheming out, to enable the whole lot to be assembled, and yet make the valve-gear easy of access when necessary, and I certainly agree, having "had some." The small angle around the cab front, fitting closely to the boiler, and the extension on the left-hand side which houses the end of the reversing-gear, ran away with a lot of time. As to the boiler itself, this is of the round-back pattern, as fitted to the rebuilt No. 857 "Lord Howe" (and how!). The internals are made to "Live Steam" specifications, and the barrel contains five superheater flues and twenty-two small tubes. The diameter of the barrel at the largest ring is 4⅞ in., the barrel itself being of the correct taper, the lagging exactly following its outline.

Both engine and tender are fitted with working vacuum brakes, the reservoirs for storing the "nothing" being in the tender. As can be seen by the photographs, Mr. Tucker has included all the blobs and gadgets of big sister. The trailing sands are fitted at the leading end of the tender; just the reverse to those on the Stroudley engines, but a bit nearer the coupled wheels. Note the vacuum brake cylinder behind the drag beam; this is similar to those I fitted to "Maisie." The whole bag of tricks is a really first-class job, and Mr. Tucker certainly deserves hearty congratulations on his fine work.

Time Table

Beginners and other inexperienced workers might be interested to learn of the exact time spent on each part of the engine. Mr. Tucker took a careful record right throughout the job, and here are some interesting figures :—

Engine :—

Part	*hours*
Frames	64
Hornblocks and stays	24½
Cylinders and covers	100
Piston valves and liners	29
Pistons and rods	8
Valve-chest covers	26½
Valve spindles	13½
Cylinder drains	14½
Valve setting and adjustment	6
Guide bars and yokes	45½
Crossheads	32
Connecting-rods	44½
Coupling-rods	31
Driving wheels and axles	36½
Crank axle	17½
Coupled axleboxes	21
Crankpins and return cranks	10
Driving spring nuts and plates	7
Walschaerts gear	124
Holcroft gear	72
Reversing gear	23
Water pumps and driving gear	27
Oil pump and driving gear	34½
Vacuum pump	19½
Engine brake gear	56
Footplates and steps	78½
Footplate brackets	16
Driving wheel splashers	10
Bogie wheel splashers	3½
Buffers	15
Couplings	7
Drawbar details	5
Bolts and nuts	10
Nameplates	8
Cab	78
Boiler	70
Smokebox	37
Superheater	13
Regulator	15
Chimney and dome cover	14½
Lemaitre blastpipe	3
Firebars and ashpan	19
Boiler lagging and hand rails	20½
Boiler fittings and mountings	102
Pipe work	53
Firehole doors	18½
Smoke deflectors	13½
Engine bogie	69
Erecting and assembly	60
Painting	71
Total hours on engine	1,697

Tender :—

Part	*hours*
Tender frames	24
Footplating and steps	19½
Water tank	42
Hand pump	18
Fittings	59½
Pipe work	12½
Bogie frames	54
Wheels and axles	16
Axleboxes	32½
Laminated springs	17
Brake gear	52½
Buffers	15
Couplings and sundries	7
Painting	18½
Total hours on tender	385
Grand total, engine and tender	2,082
Weight of engine empty	73 lb.
Weight of tender empty	30 lb.

Beginners often write to me and ask how long I think it should take them to build a decent locomotive. When I tell them it will probably take them about three years to build a 3½-in. gauge 4-6-0 or a Pacific, and if they want to build something in shorter time, they had better tackle "Juliet," they are often amused, and reply that they had reckoned about six months at the outside. When I started the description of the "Lassie," some of our advertisers received standing orders for the whole of the castings and material, and in several cases a request for quick delivery "as they wanted to get the engine done for the Exhibition." That was only a few months ahead, at the time!! The above figures tell a tale. Our worthy friend is an experienced engineer, with a fully-equipped workshop. Even if a beginner worked with his speed and skill, for three hours per night, six nights per week (none off for taking the missus or girl friend to the pictures, no "going to the dogs" or other evening entertainment, and no annual holiday) it would take approximately 2¼ years to complete a similar locomotive. Ponder over that, ye impatient souls!

The Railway Needed Alterations!

On measuring up the wheel centres of the $3\frac{1}{2}$-in. gauge "Nelson" class engine, Mr. Tucker found that she wouldn't negotiate his existing curves, the coupled wheelbase and the distance from centre of leading axle to centre of bogie pin being the longest of any 4-6-0 in this country. As the railway wanted some attention, the posts having gone badly and the track out of alignment, it was decided to dismantle the whole issue and rebuild it with easier curves. The new posts are of 2-in. iron steam-pipe with plates welded on each end, set on concrete foundations flush with the ground, so that if at any time it should be necessary to move the whole issue, it can easily be taken down and re-erected elsewhere. The new curves are 21 ft. radius, measured to the inner rail (same as the larger end of my own road) and the sections are all interchangeable, 32 of them forming a complete circle. There is a 25-ft. straight run between curves at each side, and a 9-ft. straight between curves at each end; the total length of run is approximately 200 ft.

The existing "Annas" are much freer running on the new layout, the 4-4-0 "Cityanna" being much faster. Three new passenger cars have been built, of the low-base crocodile type, the driver's car being fitted with a hand brake, and one of the others fitted with special foot-rests for our friend's little grand-daughter. All the wheels are rustless steel, so that the cars can be left permanently outside without coming to any harm. The height of the loading platforms above rail level is only $1\frac{1}{4}$ in., so that high speeds around the curves can be attained with perfect safety. Our friend says he thinks his next job will be a $3\frac{1}{2}$-in. gauge "Vulcan Liberation," 2-8-0. Curiously enough, I had that in mind for our next serial, K.B.P. willing, as I have received several requests for information, from prospective locomotive builders who wanted an engine powerful enough to pull the Statue of Liberty up by the roots and tow it across to the City of Lost Angels. What about it, brothers of the locomotive craft—are you for or against?

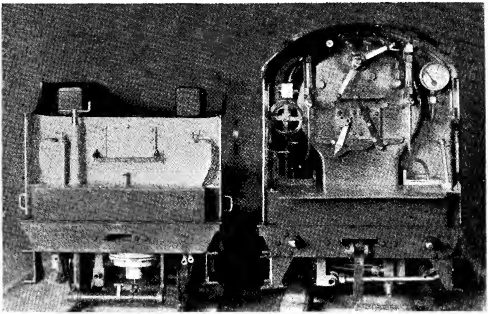


Photo by] *"Lady Anna"—the operation department* [*J. A. Smith*

Boiler Troubles

Two queries received this week, time of writing, being typical of many, I will deal with them here, which may save beginners and inexperienced workers writing direct on similar subjects. Somebody built a $3\frac{1}{2}$-in. gauge boiler for an L.M.S. 2-6-0; made, as he thought, a good job of the brazed joints, sweated up the stayheads, and tested it. Leaks promptly appeared at the stayheads, and as fast as he mended one place, another showed up. In desperation, he at last cleaned all the solder off, and silver-soldered over all the heads and nuts, only to find that the joint between the barrel and throat-plate had cracked. He tried several times to silver-solder this also, but every time the crack reappeared. Finally he cut a vee all around the joint, put end clamps on the boiler, and Sifbronzed up the vee, the result this time being that the backhead began to cave in. He wants to know the cause of the trouble, and more important still, the remedy.

Now all regular followers of these notes don't need reminding that I have again and again stressed the important point of having clean

(*Continued on page 524*)

A $\frac{3}{4}$-in. Bore × $\frac{5}{8}$-in. Stroke Vertical Engine

By J. H. Jepson

THE following design is offered in the hope that it may prove worthy of the experienced model engineer, while being quite easy to make by newcomers, provided that they have acquired some mechanical ability, and is specially suggested to any servicemen who have access to a workshop and are looking for something to make.

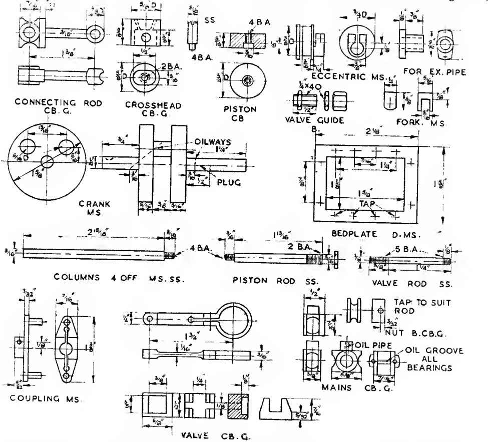
All the materials required are fairly easy to obtain even in these difficult times, no castings being needed.

Model-sized nuts and bolts are in short supply, but can readily be fitted when procurable. Meanwhile, there are plenty of cheese-headed screws about ; but do discard them in due course, they never look as well as bolts and nuts !

around 100-120 lb. pressure, according to hull and propeller design. Suitably supplied with flash steam, another 10 m.p.h. should be added.

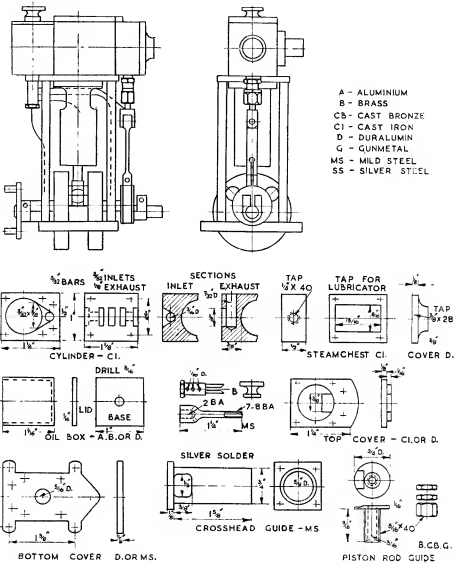
A hull of 36 in. to 40 in. would be most suitable, but the engine would easily drive a larger boat of 4 to 5 ft. long.

On 90-100 lb. pressure, it would be quite capable of towing a rowing-boat at fair speed for those who, like myself, enjoy a bit of novelty. I would add that all the features shown have been well proved by experience ; and for that reason, I ask that the design and dimensions, especially of the cylinder unit, be strictly adhered to. The builder's ability to devise ways and means of making the bits and pieces is taken for granted,



Although being primarily a high-speed boat engine, it would serve equally well as a stationary unit for dynamo driving, pumping, etc. For boat work it should give speeds up to 15 m.p.h. on

so to each be his own way of arriving at the desired end. For that reason there is a minimum of instruction, except where I think a word would be of real help.



Start with the cylinder-block and see that you get a piece of good cast-iron. In my time, I have cut bits off flat-irons, garden gates, weights, etc. Be sure to form the recesses shown at each end of the steam passages. Reamer and then lap the bore; you cannot have too good a fit here. Cut the ports as accurately as you can, however you execute the job.

If more convenient, the top cylinder cover could be cut from plate and the spigot fixed by rivet or screw. The steam-chest and cover are straightforward jobs.

The oil-box can be made up from 1-in. square brass tube or end-milled from a block of A.B.D. (see chart), or built up, silver-soldering for preference. For the crosshead-guide use a piece of steel tube, a box spanner may prove useful here, provided it is true and smooth internally.

To end-mill the crosshead recess, a stub of $\frac{5}{16}$-in. twist-drill will suffice, if suitably ground and a high speed is used. Should the crank webs prove too heavy a job for your lathe to part off (mine is a treadle) cut them roughly from mild-steel plate, drill them together, then turn in the lathe using a spigot in the chuck. The main and big-end bearings can be formed by parting off suitable lengths of $\frac{5}{8}$-in. diameter C.B., sweating in their pairs, drilling, finally forming on another spigot, unsweating and then reamering. See that the big-end passes down the crosshead guide, as this may assist in general assembly.

The eccentric fixing is very firm and allows of easy valve timing; drill the oil-hole from centre of crankshaft after the eccentric is finally set.

Some patience will be required in cutting the slot so that the screw can pinch up ; a hacksaw blade worked by hand will do the trick.

I have long since discarded the grub-screw method for securing the eccentric, as being liable to slip, while for flywheel fixing for serious work, it is hopeless.

Here is a brief summary of points for the final assembly : Check the piston for equal clearance each end of the cylinder ; make certain the valve does not touch the steam-chest at either end of its travel, and leave a little rock in the valve-nut to ensure the valve seating properly. Before actually setting the valve, adjust for equal port-opening, then set it for timing, which should be inlet just opening 10-15 degrees before dead-centre. Cylinder bore to be true with bottom face especially, likewise the bore of crosshead guide to be true with its flange. Connecting-rod to fit easily into crosshead with no side pressure, the eccentric-strap to swing freely into its fork on the valve-spindle.

Fit a $\frac{3}{8}$-in. exhaust pipe, as short as convenient, and having no sharp bends. Steam pipe to be $\frac{3}{16}$ in., but $\frac{1}{4}$ in. if the superheater is good enough to ensure dry steam. To get a nice appearance, temporarily fit together the cylinders, covers, steam-chest and cover, and oil-box ; file and polish them as one unit.

Paint the cylinder block maroon or black, also the steam-chest if of cast-iron, but leave the rest polished.

Case-harden the eccentric sheave and strap, polish only their working surfaces. Polish all other steel parts, heat them to a deep-purple and drop in oil. Do the same to all nuts and bolts to be used finally. This gives a nice finish and is rust-resisting.

For whatever purpose the engine is used, see to the alignment be it propeller-shaft or dynamo ; do not waste precious power on mal-alignment. To those who may wish to operate in flash steam, fit two exhaust pipes, keep the steam temperatures reasonable, and use an oil-pump. When built properly this should be a real engine, long-lived and hard-wearing, not intended for ticking over, but in operation allowed to purr or drone.

For really low speed, shorten the valve travel to $\frac{3}{16}$ in., the valve cavity to be $\frac{5}{16}$ in. long instead of $\frac{3}{8}$ in., thereby giving a total length to the valve of $\frac{9}{16}$ in., as against $\frac{5}{8}$ in. as shown. In this case the cylinders would be of cast bronze or gunmetal. To take care of the engine, always leave the cylinder filled with oil ; do this by feeding oil *via* the exhaust pipe and turning the engine backwards. When full the engine should be quite difficult to turn.

Remember this oil when using the engine again (don't say I didn't tell you !). Steam oil will be required in the displacement lubricator and the oil box.

In conclusion, some of these points should prove useful to that large number of users of Stuart-Turner engines, No. 10 and B.B., and can readily be applied to their engines, especially the cylinder assembly.

Through THE MODEL ENGINEER I should be very pleased to hear from any builder of this engine.

" L.B.S.C."

(*Continued from page 521*)

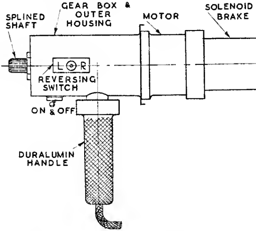
and tight threads on the stay-bolts and in the plates, so that they are virtually steam-and-water-tight even without any sweating. The sweating-up should be merely a sort of " safety-first " insurance against a slight leak caused by an undetected torn or damaged thread, also to make certain the lock-nuts on the stays inside the firebox do not come adrift. If our friend mentioned above had fitted his stay-bolts according to " words and music," he would never have had any initial leakage, so his other troubles would have been, as Mike O'Finnegan would say, stopped before they started. At the same time, if he had heated up the whole of the boiler evenly before attempting to silver-solder the crack in the throatplate joint, and then let it cool off very slowly and evenly, along with the coke in the brazing-pan, the repair wouldn't have cracked again, and there would have been no risk of opening up fresh places. The whole and sole trouble of a joint cracking open, is stress set up by unequal heating and cooling. In days gone by, I repaired two or three leaky boilers for my few personal friends, by aid of my " Alda " blowpipe and a spot of " Easyflo " ; and in the cases where the stay-heads had been sweated up, also to prevent the re-opening of the leaky place the job was done with the boiler in a bath of boiling water, and left in it to cool down slowly.

The second query refers to the blue-prints for " Dyak," issued from THE MODEL ENGINEER Publishing Department. Several purchasers of this set want to know why the boiler is shown with a butt-jointed firebox, contrary to my instructions and illustrations in the " serial " describing the engine ; and one reader who has actually tried to make the firebox with butt joints, has got in trouble with it, and seeks aid to get him out. The firebox should have been shown with flanged joints, as in all my other boilers ; how it was shown otherwise, is a matter that only the tracer can explain. Anybody who has the back numbers of this journal, dealing with the construction of the boiler, can verify that flanged joints were specified, and illustrated in my own original drawings. However, butt joints between the firebox sides and crown sheet, and the end plates, are quite all right in the smaller sizes, as long as they are well brazed and have a good fillet of brazing material left all around. The said brazing material should be a good grade of strip or spelter, so that there is no chance of it melting when the tubes are silver-soldered in. The last gauge " O " boiler that I made—and if I know anything about it, quite definitely the last, as I hate " watchmaking "—had a butt-jointed firebox, the joints being made with No. 1 Sifbronze, and has given perfect satisfaction.

AN ELECTRIC SCREWDRIVER

By H. J. Perraton

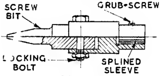
WHEN a good deal of screwdriver work has to be done on really heavy-gauge screws, such as 3-4-in. type, the conventional hand screwdriver imposes a great deal of strain on the wrists and hands, and the idea of a power-driven tool has many times appealed to me; but the cost of such an appliance is, of course, considerable in these days of enhanced prices. However, there are many ex-Government R.A.F. appliances to be had for a mere gift of a price, quite convertible to a number of uses. Such a fitting can be found in the 24-volt reversible a.c.-d.c. geared motors advertised in THE MODEL ENGINEER at various times. Knowing these motors from experience in the R.A.F., they were used on certain types of aircraft for opening and closing the cowl gills on the engine cowling. I recently purchased one of these motors for the bargain price of £1 1s. 0d. as advertised; and



it is well worth the cost, for they contain a beautiful set of "sun and planet" gears, a well-constructed motor with two field windings, compound wound armature and, last but not least, a solenoid brake, or electrically-operated clutch which comes into operation immediately the current is switched off and prevents the motor overrunning, a very necessary feature with a gear so low as that fitted to these motors (about 1,000 to 1). An additional feature is an overload clutch fitted to the armature shaft, which is hollow.

On stripping these motors, they will be found to contain in addition to the above feature, two automatic trips or switches which are connected to the respective field windings, and prevent the motor making more than a few turns in either direction. This last feature is of little use for any purpose other than that for which these machines were originally intended and can be easily removed by simply loosening the large brass locking-nuts on the shaft housing, and taking off the bakelite ring which holds the spring-loaded contacts and removing the connections. In the case of my own motor, I stripped it completely, first removing the outer housing by undoing the outer brass lock-nut on the shaft housing. This exposes the gear-box, which, in turn, can be removed by taking out the four holding-down bolts on the gear-box flange. The machine then comes away in two pieces, the gear-box in one half and the motor and solenoid brake together in the other. I then loosened the four locking-nuts on the motor housing, withdrew the long bolts, and, after removing the brushes from the holders, withdrew the armature from its tunnel.

I then proceeded to loosen the four bolts on the solenoid flange, and after unscrewing and loosening all connections to the brush gear, removed the solenoid and housing complete. I next turned my attention to the overload clutch.



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I calculated that this feature would result in slipping when the considerable strain of screwing was applied; so I removed this completely and attached the small driving pinion direct to the armature shaft, by means of a small steel bush which I turned up in the lathe, and sweating the two together by means of soft solder. This, in turn, was soldered to the flange on the armature shaft after having been accurately centred, so that the complete job was like a solid shaft and pinion, a final skim in the lathe with a front turning tool, running the job between centres, completed the task.

On examining the gears, I found the box to be filled with a black sticky grease, which later proved to be graphite grease, the object of this being that, when running at high altitudes this mixture will not freeze, and it is just as well left where it is. I then reassembled the machine, with the alteration to the overload clutch as previously mentioned, and brought out the three connections of the motor to the bakelite terminal block which is fitted to the side of the gear-box; one terminal marked "neg." forms one common lead, the other two being the free ends of the two field windings which are connected through the armature (it is a series-wound motor). I now removed the two trips (mentioned earlier in this narrative) and along with this the bakelite ring with spring-loaded contacts, thus cutting out this part of the gear altogether. When connected to 24 volts d.c. or a.c., the motor would now run in either direction, depending upon whichever field

(Continued on page 527)

Proposed Union Nut and Nipple Standards

By Jos. N. Liversage, A.M.I.Mech.E.

HAVING, over the past 25 or so years, attempted quite a number of model locomotives from "O" gauge to 7¼-in., all with their complement of small bore pipes for this, that and the other—pressure gauges, steam pumps, water pumps, injectors and the like—I came to the conclusion, before the war, that it was high time that my pipe unions and fittings should be standardised.

To some people this word may be anathema, but to me, and to many others who may be inclined to use the sizes given, it will certainly result in an appreciable saving in time, patience and labour. When a boiler requires testing, or an injector fitting, it should be an easy matter to take from one's stock, suitably dimensioned nipples and union nuts to complete the assembly, without having specially to make each item separately. Many is the time, when repairing or re-vitalising dud boilers, that I have had to make a dozen or so special and varying sized unions, in order to carry out a water test. This work takes time out of all proportion to the results achieved, and as the testing is the main item on the programme, the details leading to that end are often badly "skimped." This leads to leakages and other trouble.

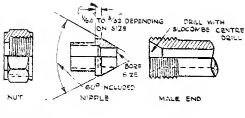
When I first standardised these fittings, I found, of course, that they would not fit all my previous efforts, but now after the passage of time, I think that I can fairly say that 90 per cent. of these universal fittings are interchangeable.

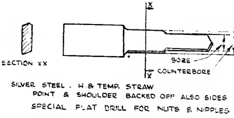
I therefore submit the following table of dimensions, all of which have proved satisfactory after prolonged trial, and which I have found applicable to all the usual sizes or scales of miniature locomotives.

The dimensions themselves are self-explanatory and require no amplification. I have, in the main, cut down considerably the length of the nut, so that it shall be more in keeping with its full-size counterpart. In fact, the ⅜-in. size could be used for full-size work without disgracing its commercial twin.

Some folks may criticise the use of the tailed nipple, but from my own part, I would not use any other type. The short type, consisting of a head only, I would not use at any price, as, for some reason or other, I have never been able to make what I consider a satisfactory job with them. One great fault is that the clearance between the pipe and the collar of the nut is necessarily small. Bend the pipe, and can you get the nut on ?—No !

One final word regarding the fixing of the nipple to the pipe. Never be tempted to use soft solder. Always silver-solder, it is both easier and better, and, above all, stronger and will allow a misaligned pipe to be pulled straight.





NUT

Pipe size O/D in.	Hexagon Across flats in.	Length in.	Tap Dia.&Thread in.	Depth in.	Drill Collar in.	Drill C'bore in.
1/16	3/16	3/32	5/32×40	5/64	0.096 (41)	0.128 (30)
3/32	1/4	1/8	3/16×40	3/32	0.128 (30)	0.157 (22)
1/8	5/16	3/16	7/32×40	5/32	0.159 (21)	0.189 (12)
5/32	3/8	7/32	9/32×40	3/16	0.189 (12)	0.252 (F)
3/16	3/8	1/4	5/16×32	7/32	0.232 (A)	0.282 (K)
1/4	7/16	9/32	3/8 ×32	7/32	0.299 (N)	0.345 (S)
5/16	9/16	11/32	1/2 ×26	9/32	0.377 (V)	0.460 (15/32)
3/8	3/4	7/16	5/8 ×26	3/8	0.440 (7/16)	0.580 (37/64)

Nearest drill size.

NIPPLE

Pipe size O/D	Stock bar	O/D head	Diam., tail	Length, tail	Drill Bore	Drill C'bore	Socket, Use Slocombe Drill
in.	in.	in.	in.	in.	in.	in.	Letter
1/16	1/8	0.125	0.093	1/8	0.050 (55)	1/16	H
3/32	5/32	0.156	0.125	5/32	0.075 (48)	3/32	D
1/8	3/16	0.187	0.156	3/16	0.095 (41)	1/8	D
5/32	1/4	0.250	0.187	7/32	0.120 (31)	5/32	B
3/16	9/32	0.281	0.230	1/4	0.150 (24)	3/16	B
1/4	3/8	0.343	0.296	9/32	0.200 (7)	1/4	B
5/16	1/2	0.455	0.375	5/16	0.235 (B)	5/16	G
3/8	9/16	0.562	0.437	3/8	0.325 (P)	3/8	Special 60°

Nearest drill size

An Electric Screwdriver

(Continued from page 525)

connection was used to complete the circuit, for as long as the supply was connected.

I now turned my attention to the main housing, that is the gear-box housing. Attached to this by a riveted flange is a screw-cut sleeve which originally was attached to the " Breeze Cable " connection. It is about 1 in. diameter and is screwed 20 t.p.i. This seemed to suggest a pretty solid basis for some form of a handle, so I placed in the 3-jaw a piece of " Dural " rod about 1½ in. thick, and turned down about 6½ in. of its 8-in. length to 1 in. diameter, and then substituted a knurling tool for the cutter in the tool-post, and knurled this portion of the rod with a good heavy pattern. Next, I bored the rod right through with a 19/32-in. drill to allow for the cable which I arranged to go through it. I now reversed the rod in the chuck so that the large end faced the tool. This piece was 1½ in. long ; I bored it out with the aid of a boring-tool and threaded the inside 20 t.p.i. to fit the screwed sleeve on the housing of the motor. This made a perfectly rigid handle, although perhaps a little further forward for the balance of the motor generally.

I now obtained two switches, one a one-way two-pole toggle pattern for the " on " and " off " control, and another of the double-pole two-way variety of the same pattern for the " clock " and " anti-clock " rotation. These two switches I placed inside the main housing, the " on " and " off " one just forward of the handle so that it could be operated by the forefinger, and the two-way one on the right of this on the side of the machine. The main body of the switch is inside the main housing ; only the wires protrude and their flush appearance quite conforms to the general outline of the motor. Having completed the wiring and tested the motor, which would now operate in either direction by simply putting the right-hand switch to left or right, I was now faced with the problem of making a suitable screwdriver bit and fitting this to the splined shaft of the motor. I was fortunate in this case in that the motor was supplied with a splined sleeve, the other end of which had a plain sleeve of fairly generous proportions, having a bore about ¾ in. I now turned up in the lathe a piece of mild-steel of 1 in. diameter and 5 in. length. I turned down a portion of this to ¾ in., a dead fit into the plain portion of the splined sleeve. I then reversed the piece in the chuck and turned the remainder down to about ⅜ in. I then filed a tapered screwdriver point at the end of this. The whole was then case-hardened with the aid of a little Casenit, and a nice bright sitting-room fire. I should have said that, before case-hardening, I bored a hole of about 7/32 in. right through the ¾-in. portion of the screwdriver bit. Two corresponding holes were made in this portion of the splined sleeve so that a 7/32-in. bolt could go right through the whole issue, and keep them firmly in place. I now found that when holding the screwdriver in the upright position, the splined sleeve dropped off the shaft ; so, in order to lock the splined sleeve to the shaft, I drilled a hole in the sleeve and tapped a 3/32-in. grubscrew to make the whole thing secure.

I have made additional screwdriver bits to fit the same sleeve, one long and one short for awkward screws and in places where there is very limited room for manoeuvre.

The whole machine or tool is very satisfactory and will drive home a 5-in. × ⅜-in. wood-screw with ease ; it does not even slow up the motor and the screw can be driven right home up to the head. Similarly, by reversing the motor, the screw can be unscrewed with equal ease, with a minimum amount of pressure applied manually to the tool.

The diagrams show the general arrangement of the tool, the whole cost of which was £1 1s. 0d., plus about 24 hours of my spare time.

ALTERING A BOAT DESIGN

By J. Melville Thomson

VERY often, when building to a certain design, one would like to make slight alterations to the length, breadth, or draught to suit special requirements. This makes it impossible to follow the original *exactly*, and mistakes often occur. Yet, there is no great difficulty in making a new design that will have the main features of the original; that is to say, the same coefficient of fineness. It should be realised, however, that very drastic changes, especially to the underwater portion, may result in a complete loss of the advantages possessed by the original. Increasing the beam, for example, will improve stability, but probably at the expense of increasing the resistance to be overcome by sail or engine. Increasing the length will usually have a good effect; decreasing it will not. Increasing the draught will call for an increase in displacement that it may only be possible to achieve with ballast, and for the same beam will tend towards instability. But these observations are not to be taken as final and complete. They are thrown out at random to warn the novice in these matters against expecting the same performance from a boat, the dimensions of which he has radically altered from one that had a good design. He may be lucky and get better results, but, in the very advanced stage to which boat design has reached, it is unlikely. Perhaps it is safe to say that least damage is done by increasing the length, and it is dangerous to decrease the beam.

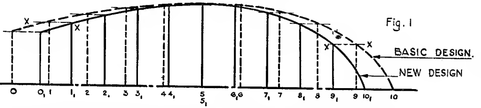


Fig. 1 shows a method of reducing the length of a basic design while preserving the beam and relative half-breadths at each section. By simply reversing the procedure the length could be *increased.*

Draw on a piece of paper the centre line for the altered design. Mark off the length required and divide this length into the same number of sections, or, to give them their proper name—ordinates, as appears on the basic design. This can be done by scale or dividers, but it is important that there should be the same number. Apply this tracing so that the mid-section (No. 5 in this case) coincides with the mid-section underneath it. Draw the lines XX, which are parallel to the centre line of the boat. Where they cut the new vertical ordinates 0, 1, 2, etc., are the points for the new curve.

This can be used where a deck line or a waterline is to be copied, and where no other information is given. But, of course, if sections or "moulds" are given it is only necessary to lift the widths required from them and apply the widths to whatever spacing of ordinates one needs. There must be the same number of ordinates as in the original, that is all. This description of a very simple process has been given to lead up to what follows.

When it is required to alter the beam, or beam and draught together, a similar but very slightly more involved procedure is necessary. Fig. 2 shows how to get a new design with a greater beam and a greater draught from a basic design, which is shown dotted. How to do the opposite will be described afterwards. The curves in the illustration have been distorted for the purpose of clarity. It is not meant to be a real design and the principle applies for any type of craft whatever.

Draw the centre line, moulded breadth, base and waterlines of the proposed design on a piece of tracing paper. There must be the same number of waterlines as on the original and they must be spaced in the same proportions. First of all, apply the tracing so that A on the basic design coincides with A_1 on the new design. Pivot the tracing; that is to say, the new design, until the ends of that waterline exactly touch the vertical moulded breadth lines, as at ZZ. Now project the points X,Y, etc., on the basic design up or down *parallel to the centre line of the basic design* until they cut the new waterline, as shown at X_1Y_1, etc. These will be the points through which the new sections will pass on that particular water line.

Now move the tracing paper until B coincides with B_1, and the ends of this waterline meet the moulded breadth lines of the basic design. Project the points where the sections cut the basic water line as before and carry on in the same way for C or any other waterlines required.

Draw in the new curves with a penning batten and "fair" them up. If the job has been done carefully, very little fairing will be required.

Where the proposed design is less in beam—the draught can be less or more in either case, it makes no difference to the method, although it is probable that for the same displacement draught will alter inversely with beam—where it is proposed to decrease the beam an extra process is involved. It is not a difficult one, but for some it may be a little tedious. If the

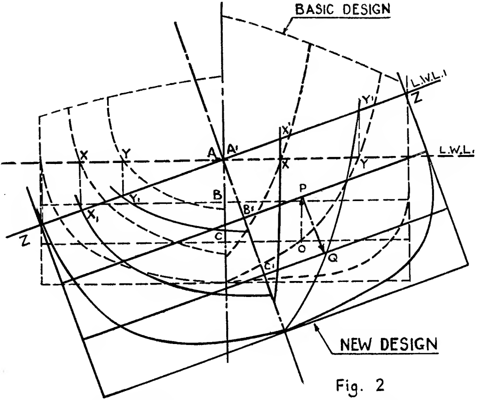


Fig. 2

basic design is not on tracing paper it must be traced. Afterwards draw the centre, moulded breadth, base and waterlines of the proposed design; only this time it need not be on tracing paper. Do the opposite from what was done before and apply the basic design on top of the new design, making the centre points, A, B, C, etc., coincide with each shift. Project the intersections of the waterlines up or down, parallel to the centre line of the new design. Always draw parallel to the smaller of the two. Where these cut the new waterlines prick them through with a needle or the "pricker" to be found on some drawing pens, on to the new waterlines. It will be seen in practice that this is quite a simple reversal of what was done before.

In both instances there is a way of avoiding shifting the tracing to each waterline. It can be seen at O, P, Q, in Fig. 2. Project vertically up or down to the centre line of the smaller design and come off square from the tilted waterline, which is the load waterline or the one which coincides at the centre lines, and mark where the squared line cuts the waterline of the new design, which will be a complementary waterline to the one started from. Like many simple things it sounds involved. It means drawing twice the number of lines and it is easier to make a mistake, but it has the advantage of not requiring to shift the tracing each time.

If it is required to alter the draught alone, the method described in the first illustration would apply. The basic and the new load waterlines being made to coincide.

Any of these methods of altering a design is preferable to the ardous one of doing it mathematically or the questionable one of going by eye.

Guildford Model Yacht and Power Boat Club

THE power boat section of this club, organised a highly successful meeting on March 24th, when Mr. F. A. Love gave a talk on the building of his $3\frac{1}{2}$-in. gauge "Bantam Cock." Members of several other clubs from the area were well represented, and the general opinion was that this type of meeting should be repeated. In view of the growing interest in model engineering in the district, the power boat section (who are responsible for "general" model activities) are going ahead with a varied and interesting programme for the coming autumn and winter. Anyone interested should contact the Power Boat Secretary: B. PILLINER, Chichester Place, Epsom Road, Guildford.

*Railway Interlocking Frames

By O. S. NOCK, B.Sc., M.I.Mech.E., M.I.R.S.E.

No. 11. (a) Evans O'Donnell Type. (b) Great Central Type. (c) McKenzie and Holland's "Cam and Tappet" Type.

BEFORE proceeding with detailed descriptions of some of the more modern types of locking frame, I am devoting one article of this series to a brief mention of some older types, which, though not embodying any different principles, yet illustrate how the three systems of "direct lever," "indirect lever," and "catch handle" actuation were worked out in the designs of various manufacturers, all using the now almost universal method of tappet locking.

As all three of the frames about to be described were widely used on the British railways, it is hoped they will be helpful to those model makers who endeavour to make their layouts as correct to detail as possible. Of these the Evans O'Donnell frame, using catch handle actuation, was used on the South Eastern and Chatham Railway, though actually its widest application was on some of the British owned railways in South America.

The "Direct Lever"

The example of "direct lever" actuation is that used on the Great Central Railway; this frame was made by both the Railway Signal Company and McKenzie and Holland, though with certain detail modifications it can be considered as an R.S. Co. standard, and as such used on the London, Tilbury and Southend, and again on some of the South American lines. The Lancashire and Yorkshire also used the same general type. The McKenzie "cam and tappet" frame was an adaptation of the famous cam actuation designed by that firm to use tappet locking, instead of the original rockers. This "cam and tappet" frame was extensively used on the North Eastern Railway.

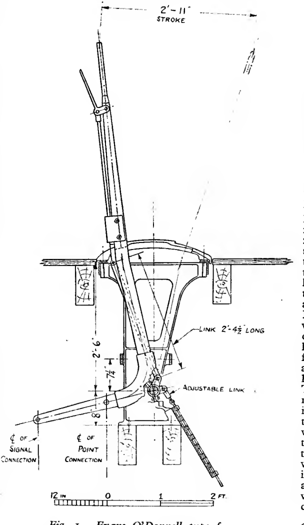


Fig. 1. Evans O'Donnell type frame

The Inclined Trough

The Evans O'Donnell frame is illustrated in Fig. 1. It is worthy of particular notice on account of the position of the locking trough. In the frames previously described in these articles, with the exception of the Saxby "rocker and grid" and the L. & N.W.R. types, the locking troughs have been arranged more or less horizontally, making it somewhat difficult to gain access to the locking in the limited space between the trough and the cabin floor. In some cases, as we have seen, the cabin floorboards had to be taken up for inspection or alteration of the locking mechanism. The Evans O'Donnell apparatus, with its steeply-inclined trough, makes it very easy to get at the locking, and this arrangement was later adopted in the Saxby 1914 and 1924 types, which will be described later.

In the Evans O'Donnell frame

*Continued from Vol. 95, page 617, December 19, 1946.

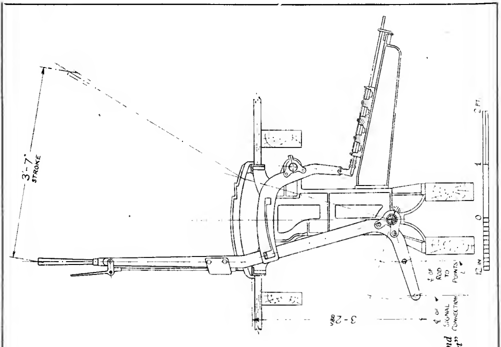
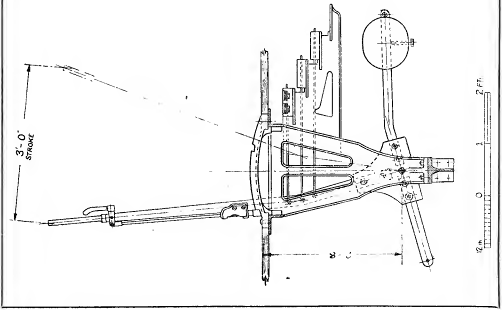


Fig. 4. Right McKenzie Holland "cam and tappet" apparatus

Fig. 2. Left G.C.R. type apparatus



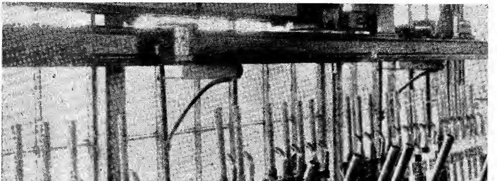


Fig. 3. G.C.R. type of locking frame, showing catch handles in front of the levers

the downward extension of the catch rod is connected to a link, which, passing to one side of the lever, transfers the line of pull of the catch rod from back to front of the lever, as shown in Fig. 1. The locking is operated through the agency of a loose rocker on the main lever shaft. The cross link is attached to an arm of the rocker at a point 3 in. from the centre of the lever shaft. When the catch is raised the upward movement of the catch rod moves the loose rocker so that this arm assumes a vertical position, and in so doing lifts the locking tappet by about $\frac{1}{2}$ in. Owing to the vertical position of this arm there is no movement of the locking during the stroke of the lever, but the releasing of the catch, on completion of the lever stroke pushes the rocker further in a counter-clockwise direction and lifts the locking tappet a further $\frac{1}{2}$ in.

Two Movements

The Great Central Railway frame is illustrated in Fig. 2, while a photograph of one such frame installed at a busy junction is reproduced in Fig. 3. The one noticeable peculiarity about this apparatus is the shape of the catch handle, which is in front of the lever. This is somewhat similar to the L. & N.W.R. stirrup type of catch, in that two distinct movements have to be made by the signalman in order to raise the catch and then pull the lever. The long tappet strokes inevitable with direct lever locking are very much in evidence in this frame; the topmost tappet of the three shown on the drawing has a stroke of $11\frac{1}{2}$ in. As regards general construction, the design is conventional, except that the standards are mounted on cast-iron girders, the cross-section of which is T-shaped.

The "Cam and Tappet" Type

The McKenzie and Holland cam and tappet apparatus is shown in Fig. 4. The lever, quadrants, and the general method of their mounting can be considered the same as in the "cam and rocker" frame, described in THE MODEL ENGINEER for June 20 and 27 last. There are certain small differences in detail, but they are not of sufficient account to be described here. In this apparatus the cam is mounted at the front instead of at the back, though the principle of actuation is just the same as in the earlier frame. In addition, to the North Eastern Railway, this "cam and tappet" type of frame was used on the Northern Counties Committee line of the Midland Railway, in Ireland; on some of the South Wales lines, and extensively on the Highland Railway.

(To be continued)

Queries and Replies

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed "Queries and Service," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of a specialist, or outside consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query, but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 8024.—The "M.E." Home Cine-Projector.

P. J. H. G. (Newcastle-on-Tyne)

Q.—With regard to THE MODEL ENGINEER ciné projector, which was the subject of a series of articles in Vols. 76 and 78 of THE MODEL ENGINEER, I have difficulty in finding the concluding articles describing the double claw movement, and I shall be glad if you would let me know in which volume I may find this description.

R.—The improved claw movement for THE MODEL ENGINEER home ciné-projector was described in the issues of THE MODEL ENGINEER dated May 19th and June 2nd, 1938. You do not mention the disc shutter, which is a necessary adjunct to the improved claw movement, but this was dealt with in the issues dated March 24th and April 21st, 1938. Messrs. Roox Products, of Alton, Hants., are issuing blueprints of the machine, including these components, and also castings and parts for its construction.

No. 8023.—Lathe Bearings.

B. A. W. (Southsea)

Q.—Having decided to purchase a lathe for instrument work, I should be pleased with your advice in making a suitable choice. Looking through the catalogues, etc., I noted several good-class precision lathes with Timken roller- or ball-bearings in the headstocks. I have read and heard on several occasions, that this type of bearing is liable to produce ridges on the face of turned work. Can you please give me the reason for this, and why do makers of precision lathes make them with this type of bearing? What are the advantages and disadvantages of such bearings?

R.—Most of the high-class precision lathes with which we are acquainted, are fitted with plain bearings, and it is our conviction, as a result of experience, that this form of bearing is very satisfactory when properly fitted, and presents less serious problems in design than any form of rolling bearing. It is well known that many modern lathes are fitted with roller bearings, apparently with complete success, but many practical objections have been made against them. The general idea is that they lack the steadying and shock-damping properties of plain bearings and are thus more prone to produce chatter or waviness in finished surfaces. By "preloading" the bearings, this tendency can be more or less counteracted, but the criticism may be made that by introducing friction in this way, the primary object of such bearings is defeated. We do not advance this as our personal opinion, but it is a very prevalent one among engineers.

It may, however, be taken for granted that all reputable lathe manufacturers have given the matter of bearings very close consideration, and whatever type of bearings they fit will be found capable of giving good results in practice.

No. 8027.—Model Boiler Trouble

W.L.A.F. (Bath)

Q.—Some years before the war, I built a 2-in. scale Overtype steam wagon, with cylinders, 1 in. by $1\frac{1}{2}$ in., and $1\frac{5}{8}$ in. by $1\frac{1}{2}$ in., mounted on a locomotive-type boiler, overall length, less smokebox, 14 in. and $5\frac{1}{2}$ in. inside diameter. Being in India at the time, I was unable to obtain the size of tubes that I required, and had to use $\frac{1}{2}$-in. instead of $\frac{5}{8}$-in. diameter. Their length is 8 in., and there are 21 of them, arranged in four rows.

The firebox is 6 in. by 5 in. by 5 in., inside measurement, arranged for burning solid fuel. The boiler is built-up from $\frac{1}{16}$-in. copper; it has approximately five hundred copper rivets in it and was tested hydraulically to 300 lb. per sq. in. Unfortunately, it does not steam as well as I could wish, and I would be glad if you could give me any tips, as I do not wish to rebuild the boiler, *unless I am forced to do so*.

What is a suitable fuel? In India, I had a plentiful supply of good charcoal and got fair results, but they were not first class. I have tried a patent fuel, a kind of small bricquets, but it was useless. Ordinary house-coal is a little better, but will not maintain more than about 15 lb. pressure, whereas I want 100 lb.

R.—Although your tubes are, perhaps, on the small side, we think your trouble is primarily due to the fuel you have been using. Avoid house-coal at all costs! We would suggest a mixture of equal parts of Welsh steam coal and anthracite broken up to the size of peas. We also suggest that you carefully check the blast nozzle and chimney sizes, to make sure that the exhaust properly *fills* the chimney and maintains a steady draught on the fire. If this does not do the trick, you will have to rebuild the boiler.

Letters

The Late Henry Greenly

DEAR SIR,—Might I be allowed to add my small tribute to the memory of Henry Greenly, whose writings first intrigued me as a schoolboy in 1909.

So much was I impressed by his lucid articles that I persuaded my parents to approach him with a view to apprenticeship, and I am happy to recall that I spent a number of years as his pupil, helping in the production of many copies of "Model Railways and Locomotives," and designs for some of his notable 15-in. gauge locomotives.

Those were happy years, spent in the company of a man of remarkable scientific ability, cheerfulness and friendliness, and many years later in my capacity of chief draughtsman I had the pleasure of inviting Henry to share in some of my inventions.

I shall be among those more deeply affected by the loss of this great model enthusiast.

Yours faithfully,
Watford. A. F. BROUGH.

DEAR SIR,—I was deeply affected to hear of the passing of my old friend and colleague, known to us as H.G.

Although I seem to have known him from youth, through the pages of THE MODEL ENGINEER, I first met him in the drawing office of the Royal Aircraft Factory, at Farnborough, where I had been temporarily lent from the R.A., in 1916. I next contacted him after demobilisation at Sheffield, where he was designing the locomotive parts for Jubb Limited. He and I (as Hon. Secretary) formed the Sheffield S.M.E.E. which became very successful under his guidance. In 1919 or 1920, there was a railway strike, and H.G. offered his services to drive food trains between Sheffield and Normanton district, Jubb's foreman fitter firing for him.

In 1920 he, having finished the drawings for Jubb, to our great regret, returned to his home at Farnborough, and Jubb, I and a few friends saw him off.

The last time we met was at THE MODEL ENGINEER Exhibition, about 1934 or 5. He was exhibiting, amongst others, a magnificent $\frac{3}{4}$-in. model of a G.W.R. single-driver, and we adjourned to the buffet for an exchange of notes.

I know all your older readers will wish everlasting peace and rest to a most expert locomotive engineer, and perfect gentleman.

Yours faithfully,
Bristol. R. EDGHILL COLES.

G.W.R. Locomotives

DEAR SIR,—I was very interested to note "L.B.S.C.'s" comments, in a recent issue of THE MODEL ENGINEER, on the suggestion that some of the older locomotive designs in THE MODEL ENGINEER should be reprinted. I always thought that the four engines *Gooch*, *Brunel*, *Armstrong* and *Chas. Saunders*, as rebuilt, ran better than the Atbaras and Badmintons, possibly due to the fact that their large wheels reduced piston and consequently steam velocities to something with which the valve-gears and steam passages of the time were better able to cope. In case anyone else thinks the same and is looking up back numbers to build *Gooch*, I would like most humbly to say that "L.B.S.C." did not have room in his notes to mention all the snags which the builder should dodge. First and foremost is the stepping in of the inside frame at the front end. I think this was done to enable the engine to work round sharp curves. I don't think it is really necessary, and it has stopped me from fitting "Ten-to-Eight" cylinders. Also, it is the very devil to square up four thin frames and get them plumb when they cannot be clamped together owing to the step. The small cylinders have spoilt completely the performance of the engine, even with long travel valve-gear and a locomotive-type boiler working at 75 lb. I am now building an "Iris" type boiler to work at 125 lb., in order to boost up the power. I found it perfectly easy to fit a big displacement lubricator which seemed satisfactory with the present boiler; but I can't fit the full superheat of "Iris" boiler because a mechanical lubricator can't now be put in. The original smokebox rather seemed to leave air leaks to luck, but that would come right automatically with an "Iris" boiler. I didn't fall into that trap, but I did accept the idea that cylinder drains weren't necessary—the design used the lugs to carry the bogie stretcher—and I wished I had not. A G.W.R. friend schemed out a method of fitting them which seems likely to be the goods. Finally, you yourself, sir, if I am not mistaken, have commented on the shape of the cab. I think the designer must have taken it from a G.W.R. type earlier than the Armstrongs, and I would suggest fitting the modern type of cab as fitted when the engines were reboilered. Also, I think they had top feeds.

The tender drawing didn't seem to conform accurately to any given type, and there is something to be said for following the outlines given some years ago in the *Model Railway News*, which, I believe, to be more accurate.

In conclusion, these remarks are not meant to be a series of red lights—they are only yellows indicating where some extra caution is needed.

Yours faithfully,
West Felton. D. J. R. RICHARDS.

Stephenson's Link Motion

DEAR SIR,—I must acknowledge the letter of appreciation by Mr. K. N. Harris, which you published in your issue of March 27th, referring to my article in January, on "Stephenson's Link Motion. It is most gratifying to me to know that the reception of such articles is approved by readers, and I thank Mr. Harris for his very complimentary remarks.

With regard to his points concerning the length of the slot in the link, and its length, I would say that my illustrations in Figs. 6 and 8, were entirely diagrammatic, and were in no way intended to be scale drawings of the parts in question; the scope of the article was mainly directed to the principles of the motion, and not so much the practical details. I would, however, draw particular attention to the fact that the

longer the distance as between the eccentric-rod pins in the link (and, therefore, the length of the slot) the greater becomes the angle ø, which will cause the full link-up valve-travel to be much more than it need be, resulting in a reduced cut-off at near midstroke, which is not so desirable.

Yours faithfully,
Elburton. R. W. DUNN.

Small Screwdrivers

DEAR SIR,—I think I can suggest a way out of Mr. Hudson's difficulties. I suggest he uses cycle spokes to make his screwdrivers. This material is tough, and at the same time easy to file to a suitable edge, and is best used without heat treatment. It is sold in s.w.g. sizes and the sizes he quotes are approximately 18 and 10 s.w.g. If the work is such that a long blade can be used, quite a good idea is to put a small tap wrench on by way of a handle.

Yours faithfully,
Rugby. JOHN H. REYNOLDS.

Clubs

Newbury Model Engineering Society

A model engineering society has now been formed in Newbury.

Meetings will take place at the Tudor Cafe on the first Friday of each month, at 7.30 p.m., the first meeting to be on May 2nd, when members will be invited to "bring and show."

Hon. Secretary: G. W. ALLINSON, Westcombe, Crookham Common, Newbury, Berks. Phone: Thatcham 2250.

Leicester Society of Model Engineers

The next meeting will be held on Tuesday, April 29th, at 7, Wellington Street, at 7.0 p.m.

Mr. Charles Meadows, of the Malden S.M.E., will give a short lecture and demonstrate his methods of producing small hexagon nuts and bolts.

Final details will also be given for the visit to the Derby locomotive building works of the L.M.S. Railway, on Sunday, May 11th, and for the social evening on Saturday, May 17th.

Hon. Secretary: E. DALLASTON, 67, Skipworth Street, Highfields, Leicester.

York City and District Society of Model Engineers

The next meeting will be held in No. 8 room, Co-op Hall, Railway Street, York, at 6.30 p.m., on May 3rd. Election of Treasurer and discussion on any subject raised by a member.

Hon. Secretary: WM. SHEARMAN, 28, Terry Street, York.

The North London Society of Model Engineers

The annual general meeting of the society will be held at the offices of The Barnet District Gas and Water Co., Station Road, New Barnet, on Friday, May 2nd, at 8 p.m.

The locomotive section, in planning its programme for the coming season, has decided on the construction of a number of passenger cars. Plans have almost reached the drawing-board stage, and work is expected to commence in the near future. Braking and springing problems have provided material for discussion at recent meetings of the section.

Hon. Secretary: N. M. DYER, 97, Selborne Road, N.14. (Tel.: PALmers Green 2414.)

The Women's Engineering Society (Manchester Branch)

At the March meeting of the above society an informal talk entitled "What of the Future—is it in the Air?" was given by Miss Joy Ferguson (a member of the Society) who was well known as a pilot in the Air Transport Auxiliary during the war and is now working in London at the Ministry of Supply.

Hon. Secretary: MISS S. M. F. WADDELL, B.Com., 82, Park Hills Road, Bury.

Bath and District Society of Model and Experimental Engineers

The second annual general meeting of the above society was held at our meeting room, 6, Bath Street, on March 21st last. The annual report disclosed that twenty-three talks and six outside visits had been arranged. Consequent upon the resignation of W. A. Wheeler from the post of chairman to the society, Mr. G. Maples was unanimously elected to fill this position. The secretary, treasurer and three committee men were all re-elected unanimously. In view of Mr. J. H. Cades' desire to resign from the committee, Mr. F. H. Mole was unanimously elected to the vacant seat. The treasurer's report showed a sound financial position. This and the steady influx of new members gives the society every confidence for the coming year. Details of the society are obtainable from:

Hon. Secretary: L. A. CHAPMAN, 48, Lyncombe Hill, Bath.

West Sussex Model Engineering Society

On February 6th, 1947, at a meeting held in Bognor Regis, Sussex, it was decided to establish the above society. Activities to include all forms of scale model engineering, model railways, ships, etc., and an aircraft section. There have been some interesting meetings to date, and it is hoped to have regular weekly meetings.

Hon. Secretary: K. C. M. WRIGHTON, 11, Field House, Esplanade, Bognor Regis, Sussex.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects, which should be addressed to him at 23, Great Queen Street, London, W.C.2. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to THE SALES MANAGER, Percival Marshall and Co. Ltd., 23, Great Queen Street, London, W.C.2.

Correspondence relating to display advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 23, Great Queen Street, London, W.C.2.